

**MODERN WONDER
MAGAZINE
1938-1940
THE BEST**

Modern **Wonders**

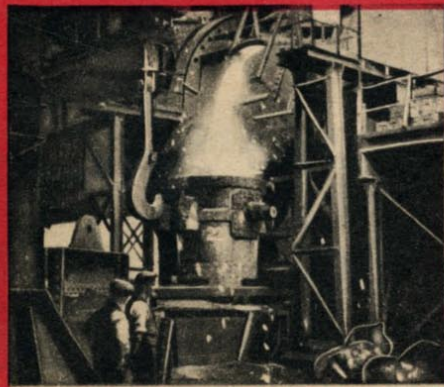
EVERY WEDNESDAY

DEC. 9, 1939. No. 134. Vol. 6

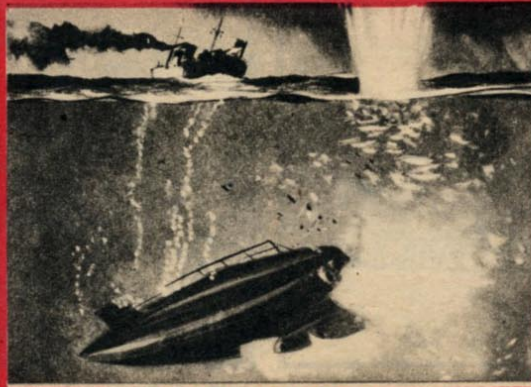
**War
Pictures**
2^d



**BRITISH WATCHDOGS
OF THE SKY**



**METALS THAT
WIN WARS**

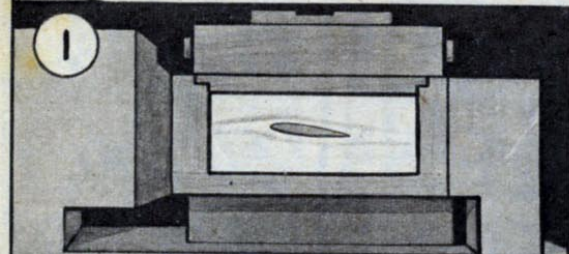


**FIGHTING THE
SUBMARINE RAIDER**

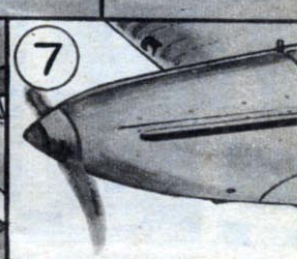
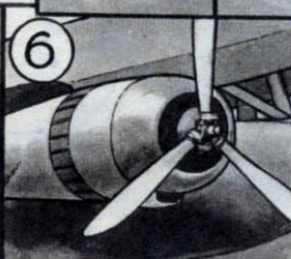
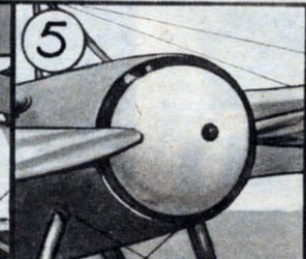
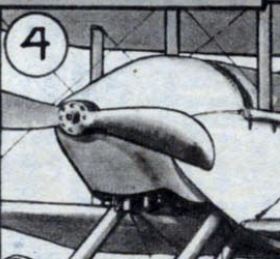
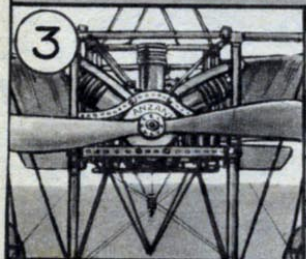
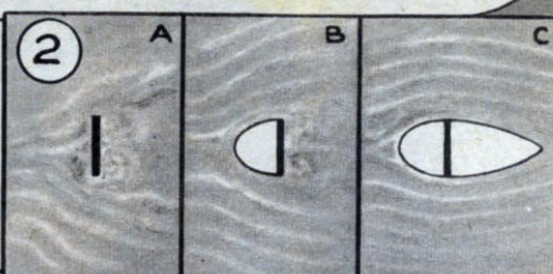


**HOW TANKS
ARE TRAPPED**

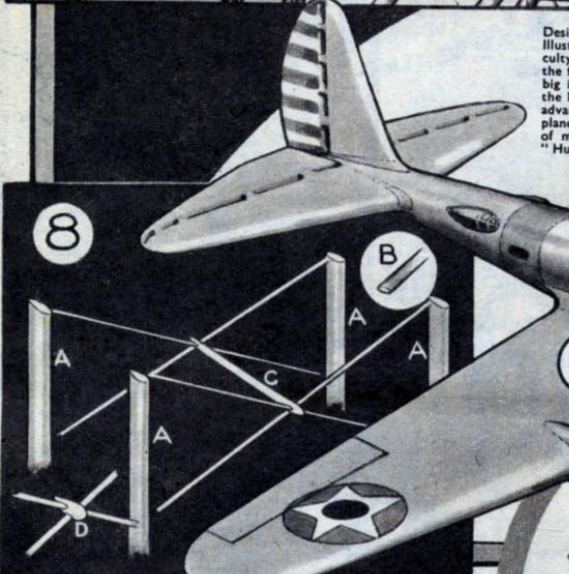
WHY THEY STREAMLINE the AEROPLANE



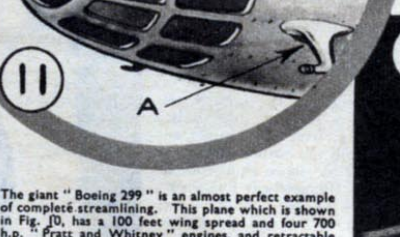
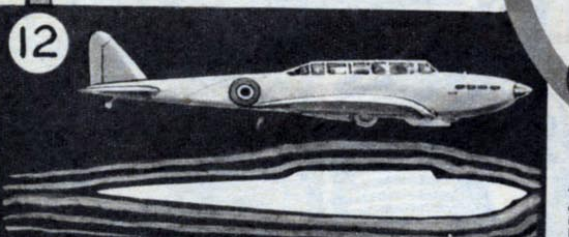
A SIMPLE method of showing airflow around a solid body is seen in Fig. 1. Here is a box in which the object is suspended while a stream of smoke is blown through from one end to the other. The effect this solid body has on the smoke stream can be seen through the observation window. In Fig. 2 three sketches illustrate simply what is meant by streamlining, and how the smoke (or air) stream is affected by a flat plate (A), a flat plate fitted with a nose (B) and (C) when it is completely streamlined with the addition of a tail.



Designers have always found engine streamlining a problem. Illustrations (above) demonstrate how they have solved the difficulty. Fig. 3 shows the engine of Blériot's plane in which he made the first aerial Channel crossing in 1909. In Fig. 4 can be seen the big improvement made in the "Sopwith" machines, as used by the R.F.C. in the early days of the Great War. Fig. 5 marks a big advance in design by the end of 1917. In this "Bristol" monoplane the rotary engine is enclosed by the fuselage, reminiscent of modern design. Fig. 6, a Bristol "Pegasus," and Fig. 7, a "Hurricane" fighter show how modern design has reached a point where little improvement seems possible.

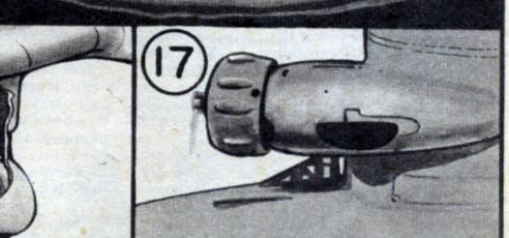
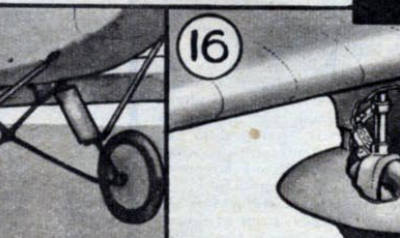
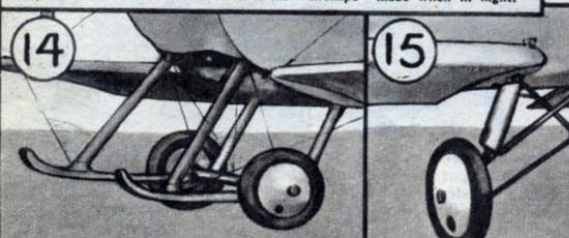


During the Great War period the majority of aircraft were biplanes, the wings of which were joined and strengthened with struts and wires. AA are the struts B; an enlarged section of the wire, and C is a streamlined wooden rod joining the front and rear sets of wires. At D is variation of the latter in which a small wooden "bullet" is used.



The giant "Boeing 299" is an almost perfect example of complete streamlining. This plane which is shown in Fig. 10, has a 100 feet wing spread and four 700 h.p. "Pratt and Whitney" engines, and retractable landing gear. Its armament is most unusual and here again great attention is paid to aerodynamics, for every gun turret (and there are many) is so shaped as to give the least possible wind resistance. Where the wings are joined to the fuselage, smoothly shaped wing fillets aid the airflow, and even the short wireless aerial mast is of streamline shape.

An example of what might be called "pencil" streamlining is the "Battle" bomber shown above. This side view gives a good idea of the aerodynamic qualities of this type and the "pencil" shape below shows the airflow around the fuselage. Controls, bracing wires, etc., are carried as far as possible inside the wings and fuselage. In Fig. 13 a different fuselage is shown, this is the "bullet" shape of the American Curtis "P.36A," a monoplane fighter used by the French Air Force. Below it is the "alrshape" made when in flight.



Undercarriages have always been a great "nuisance" to aircraft designers in that they are of no use whatsoever except when landing, and taking off. From the earliest flying days they have had to be light but strong, and their effect upon the air stream came early into the designers' calculations. Fig. 14 is a sketch of a wartime undercarriage. Struts and wires are streamlined, but their multiplicity must have had a most retarding effect on the plane's speed. The landing gear of a De Havilland "Gipsy Moth" in Fig. 15 is a great improvement on the foregoing, the wire stays are gone and the wide streamlined rear struts contain springs which take up

much of the landing and taxiing shocks. A still more improved version of a non-retractable undercarriage is given in Fig. 16. This is fitted to the Miles Whitney Straight monoplane. Here the wheel, undercarriage leg and shock absorbing mechanism are contained in a light streamlined casing, part of which is broken away to show the inside arrangement. In recent years most modern aircraft have been fitted with retractable undercarriages, one of which is shown in the "up" position in Fig. 17. This retractable wheel fits into the engine nacelle of the Avro "Anson," and it is hard to see how any further advance can be made.

On its last fateful flight, the Winnie Mae's complete landing gear was made detachable so that at the pull of a lever it fell away, thus reducing the weight and improving the streamlining. This was in 1935, and it is interesting in comparison with the modern retractable undercarriage. A landing, of course, could only be made on the belly of the machine, a difficult job even for an experienced airman.

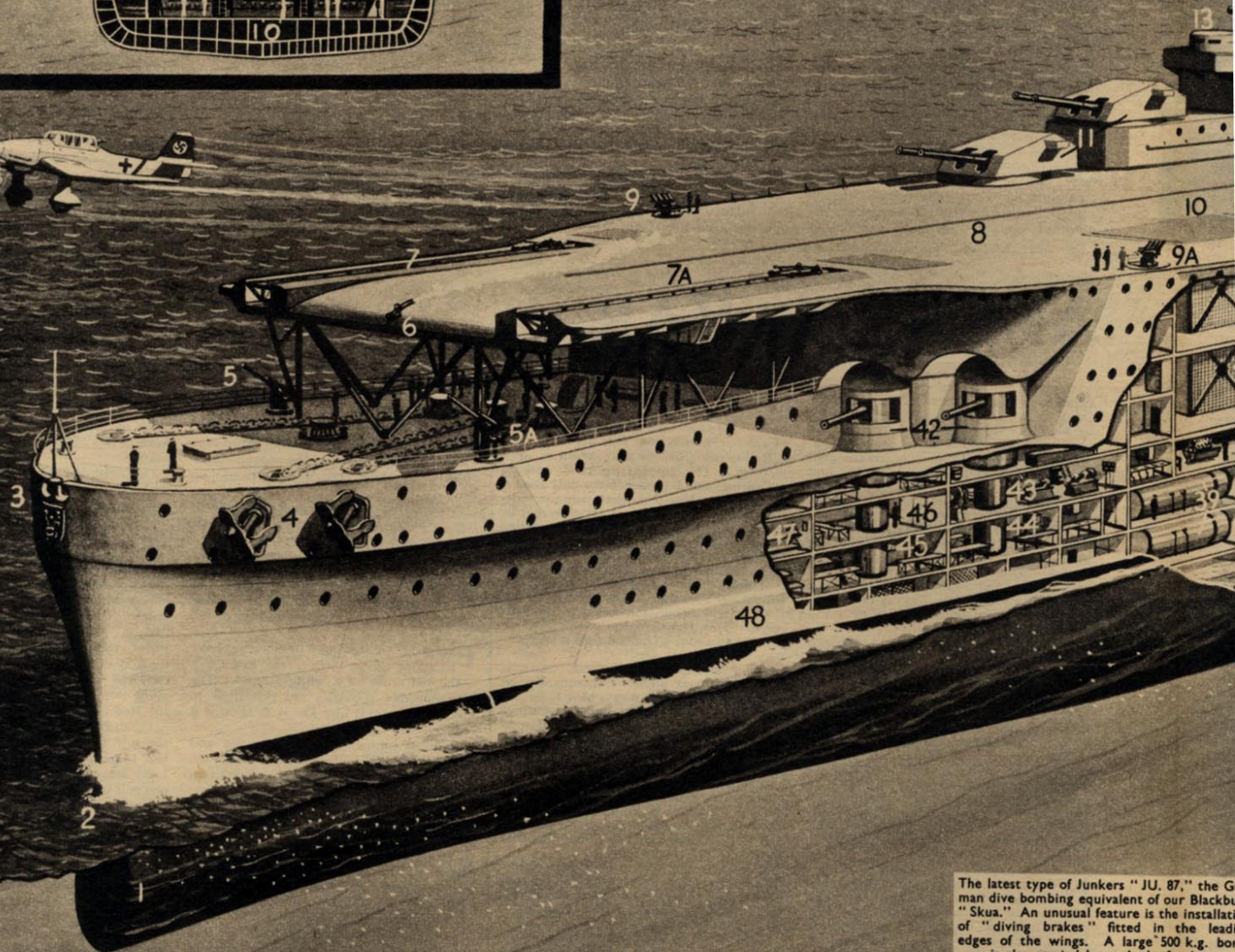
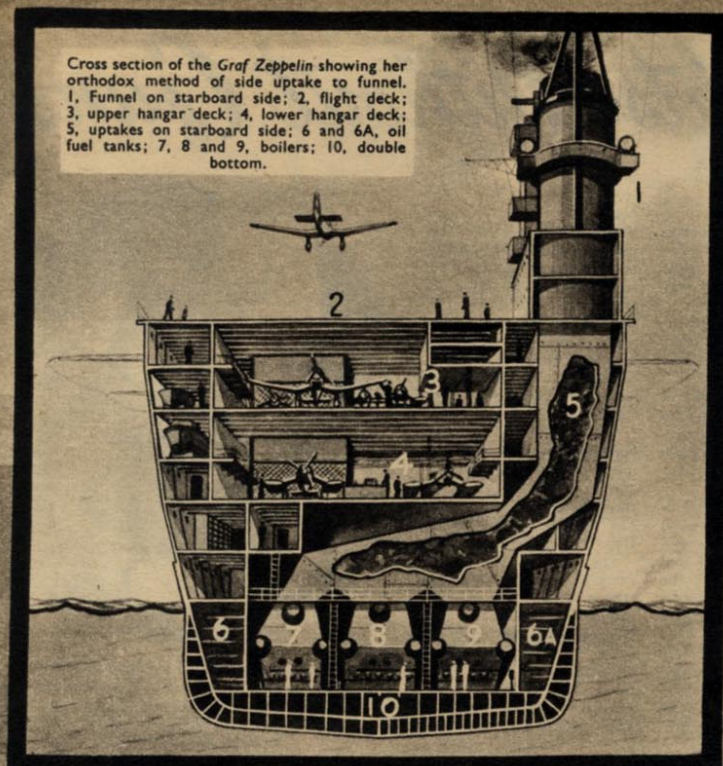
Cross section of the *Graf Zeppelin* showing her orthodox method of side uptake to funnel. 1, Funnel on starboard side; 2, flight deck; 3, upper hangar deck; 4, lower hangar deck; 5, uptakes on starboard side; 6 and 6A, oil fuel tanks; 7, 8 and 9, boilers; 10, double bottom.

NEW NAZI HO

THE GERMAN AIRCRAFT CARI

THE first aircraft carrier ever built for the Nazi Navy was launched at Kiel some fifteen months ago, and according to information received is now completed. A second vessel is being built at Kiel. Although it was expected that this ship would be of revolutionary design, the *Graf Zeppelin* is similar to our own ships and is not so large as the *Ark Royal*. She will accommodate only forty aircraft against the *Ark Royal's* sixty. The German experts had visions of the *Graf Zeppelin* operating in the Atlantic, using her dive bombers against our shipping, but she will never dare to run the gauntlet of the British Navy's

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The latest type of Junkers "JU. 87," the German dive bombing equivalent of our Blackburn "Skua." An unusual feature is the installation of "diving brakes" fitted in the leading edges of the wings. A large 500 k.g. bomb is also carried beneath the fuselage.

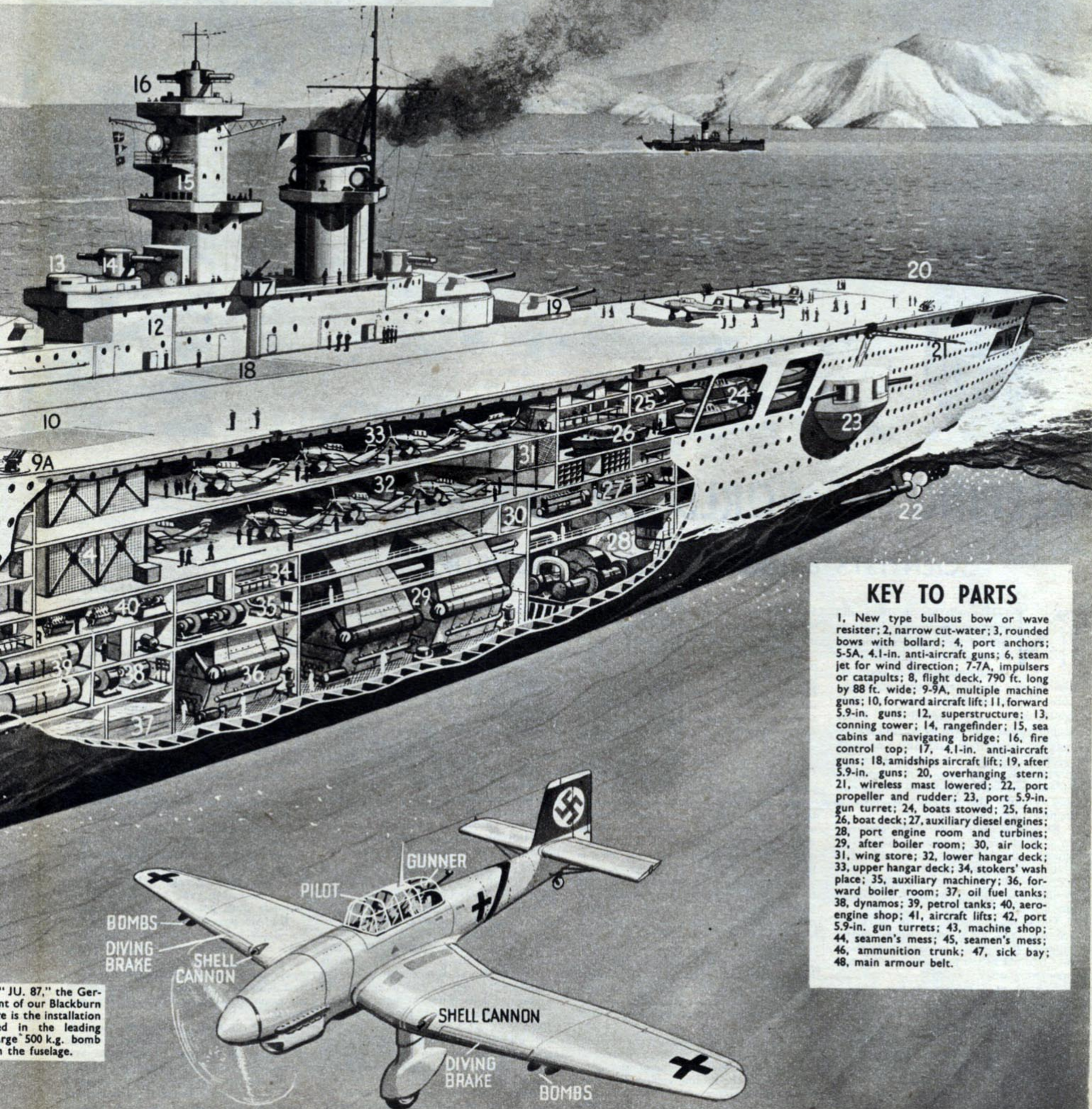
HORNETS' NEST

CARRIER "GRAF ZEPPELIN"

ceaseless vigilance in the North Sea, and is more likely to remain in the landlocked waters of the Baltic where we show her exercising with the latest type Junkers dive bombers with which she will be equipped.

She is a vessel of 19,250 tons with a speed of thirty-two knots, and carries sixteen 5.9-in. guns, ten 4.1-in. anti-aircraft guns and twenty-two smaller ones. How she will fare in a big sea with this heavy armament remains to be seen.

This is the first detailed drawing to be published of her and is exclusive to *Modern World*.



KEY TO PARTS

1, New type bulbous bow or wave resistor; 2, narrow cut-water; 3, rounded bows with bollard; 4, port anchors; 5-5A, 4.1-in. anti-aircraft guns; 6, steam jet for wind direction; 7-7A, impellers or catapults; 8, flight deck, 790 ft. long by 88 ft. wide; 9-9A, multiple machine guns; 10, forward aircraft lift; 11, forward 5.9-in. guns; 12, superstructure; 13, conning tower; 14, rangefinder; 15, sea cabins and navigating bridge; 16, fire control top; 17, 4.1-in. anti-aircraft guns; 18, amidships aircraft lift; 19, after 5.9-in. guns; 20, overhanging stern; 21, wireless mast lowered; 22, port propeller and rudder; 23, port 5.9-in. gun turret; 24, boats stowed; 25, fans; 26, boat deck; 27, auxiliary diesel engines; 28, port engine room and turbines; 29, after boiler room; 30, air lock; 31, wing store; 32, lower hangar deck; 33, upper hangar deck; 34, stokers' wash place; 35, auxiliary machinery; 36, forward boiler room; 37, oil fuel tanks; 38, dynamos; 39, petrol tanks; 40, aero-engine shop; 41, aircraft lifts; 42, port 5.9-in. gun turrets; 43, machine shop; 44, seamen's mess; 45, seamen's mess; 46, ammunition trunk; 47, sick bay; 48, main armour belt.

"JU. 87," the German of our Blackburn is the installation in the leading large 500 k.g. bomb in the fuselage.

Modern **World**

EVERY WEDNESDAY
No. 3, Vol. 1, Week ending April 6, 1940

Incorporating
**Modern
Wonders**
2^d



I WATCHED THE R.A.F. BOMBING

**HITLER'S ARTILLERY
IS NOT SO GOOD**



IS SCIENCE ADVANCING?

By Professor J. B. S. Haldane

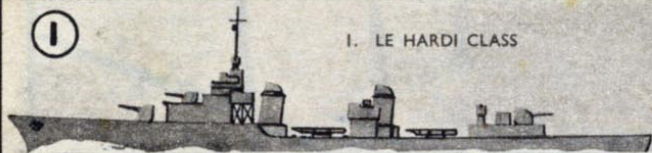


**INVISIBLE LIGHT
BEATS BLACKOUT**

DESTROYERS OF THE FRENCH NAVY

①

1. LE HARDI CLASS



2. MAGADOR CLASS



3. LE FANTASQUE CLASS



4. CASSARD CLASS



5. GUÉPARD CLASS



6. CHACAL CLASS

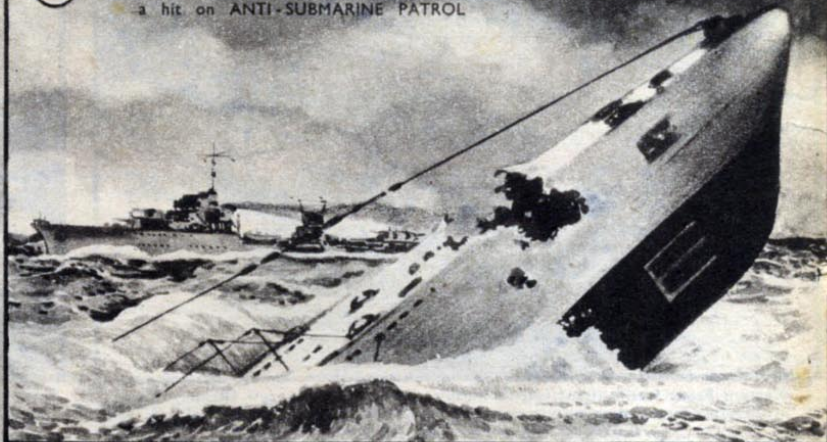


7. L'ADROIT AND SIMOUN CLASSES



②

Destroyer of FANTASQUE CLASS scores a hit on ANTI-SUBMARINE PATROL



FOR some years before the outbreak of war, France was improving and increasing her navy, with the result that now it is said to be the most "complete" in existence. This pre-war expansion would have taken her tonnage well ahead of the German and Italian fleets by 1942. The French navy excels particularly in her destroyers, some of which are super-warships possessing amazing speed and the armament of cruisers. On trial, the fastest of these vessels have travelled at 45 knots.

The seven elevations in Fig. 1 represent, from top to bottom, the following: No. 1. "Le Hardy" class: *Le Hardy*, *Mameluck*, *Epée*, *Lansgaenet*, *Aventurier*, *Opiniâtre*, *Casque*, *Fleuret*, *Le Corsaire*, *Le Flebustier*, *Intrepide*, *Téméraire*. (Laid down 1936-39). 1,772 tons, 37 knots. Guns: six 5.1-in., four 37-mm. A.A.; seven 21.7-in. torpedo tubes.

No. 2 "Magador" class: *Magador*, *Desaix*, *Volta*, *Hoche*, *Marceau*, *Kléber*. (First two completed 1938). 2,884 tons, 38 knots. Guns: eight 5.5-in., four 37-mm. A.A.; four depth charge throwers; ten 21.7-in. torpedo tubes.

No. 3. "Le Fantasque" class (shown in Figs. 2 and 3): *Le Fantasque*, *L'Audacieux*, *Le Malin*, *Le Terrible*, *Le Triomphant*, *L'Indomptable* (1933-1934); 2,569 tons; 37 knots; guns: five 5.5 in., four 37-mm., four depth charge throwers, nine 21.7-in. torpedo tubes. These vessels are a development of the "Cassard" class.

No. 4. "Cassard" class: *Cassard*, *Aigle*, *Albatros*, *Epervier*, *Gerfaut*, *Milan*, *Vantour*, *Le Chevalier Paul*, *Maillé Brézé*, *Kersaint*, *Tartue*, *Vanquelin* (1930-1932); 2,441 tons; 36-37 knots; guns: five 5.5-in., four 37-mm., four depth charge throwers, six or seven 21.7-in. torpedo tubes. Though called flotilla leaders, they are really light cruisers, the *Cassard* at trials (when light) attained the phenomenal speed of 43.4 knots.

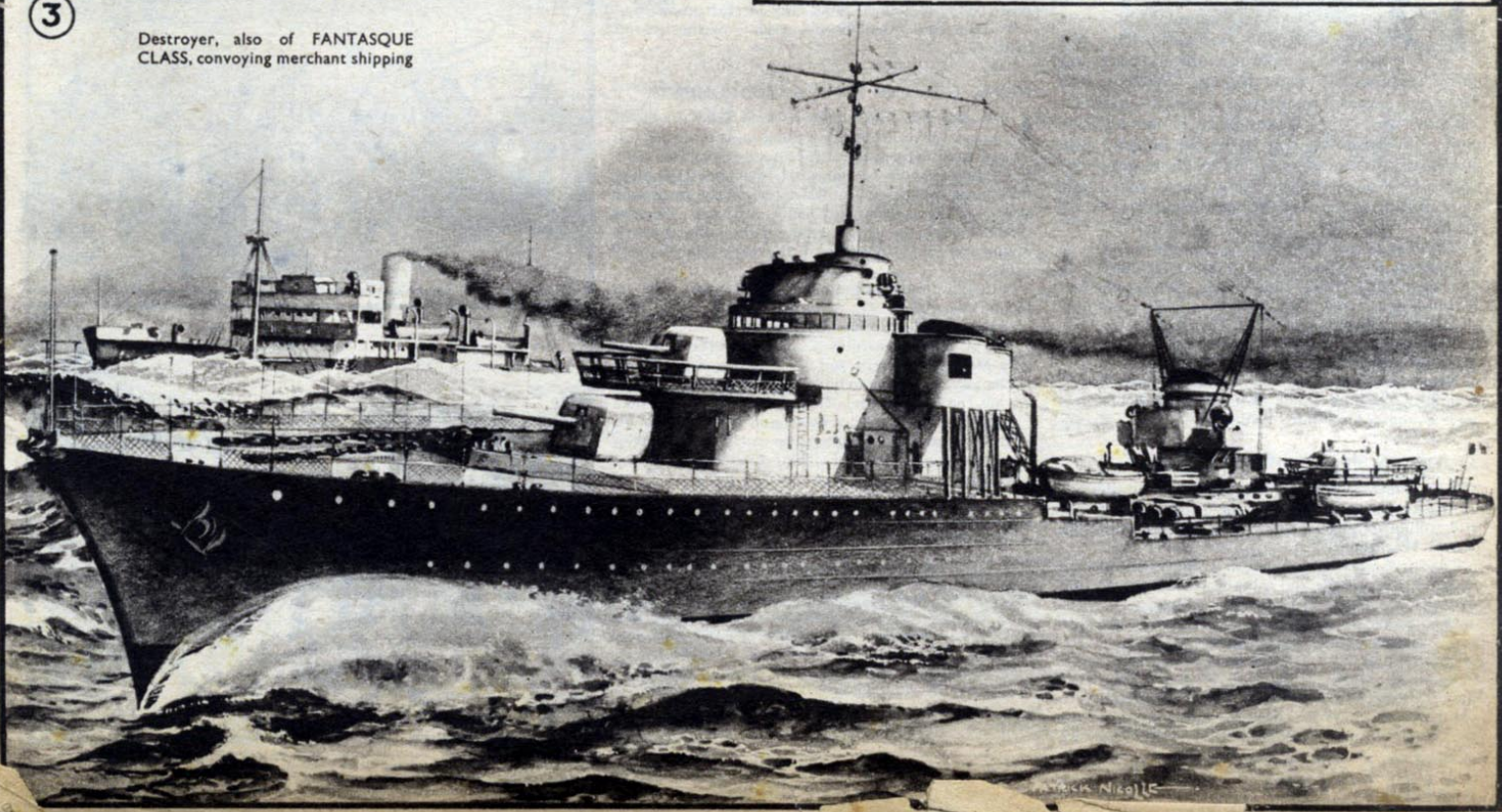
No. 5. "Guépard" class: *Guépard*, *Bison*, *Lion*, *Vauban*, *Valmy*, *Verdun* (1928-1929); 2,436 tons; 36.7 knots; guns: five 5.1-in., four 37-mm., four depth charge throwers, six 21.7-in. torpedo tubes.

No. 6. "Chacal" class: *Chacal*, *Jaguar*, *Panthère*, *Léopard*, *Lynx*, *Tigre* (1923-1925); 2,126 tons; 35.5 knots; guns: five 5.1-in., four depth charge throwers, six 21.7-in. torpedo tubes.

No. 7. "L'Adroit" and "Simoun" classes: *L'Adroit*, *Le Fortune*, *Le Mars*, *La Palme*, *La Railleuse*, *L'Alcyon*, *Basque*, *Bordelais*, *Boulonnais*, *Brestois*, *Forbin*, *Foudroyant*, *Fougeux*, *Frondeur*; 1,387 tons. *Simoun*, *Bourrasque*, *Cyclone*, *Mistral*, *Orage*, *Ouragan*, *Siroco*, *Tempête*, *Tramontane*, *Typhon*, *Trombe*, *Tornado*; 1,319 tons; 32-33½ knots; guns: four 5.1-in., two 37-mm. A.A., six 21.7-in. torpedo tubes.

③

Destroyer, also of FANTASQUE CLASS, convoying merchant shipping



80 knots

STRUGGLE on and under THE SEAS

ATTACK AND DEFENCE TACTICS OF UNDER-SEA RAIDER

GERMAN submarines—the marauders of the seas—are daily matching their cunning against the navy. In attempting to do all the damage to shipping they can, they also try to break the blockade which prevents Germany from obtaining supplies of raw material from the world markets.

During the first few weeks of the war the U-boats have succeeded in sinking a number of merchant ships of various nationalities. But the stalker itself is stalked.

On the right a diagrammatic cross-section of a submarine is shown. Germany's larger ocean-going submarines displace between 700 and 800 tons, and carry sufficient fuel to permit them to remain on stations near the shipping routes for perhaps ten days to a fortnight.

Such submarines have four torpedo tubes forward and two aft; carry a total of perhaps twelve to fifteen torpedoes; mount a 4.1 inch "wet mount" deck gun; have a surface speed of around 19 knots, and submerged speed of 8 knots. The crew consists of about forty officers and men.

STALKING FOR PREY

THE panel to the right indicates how a submarine stalks its prey. A submarine at station usually idles on the surface at night, charging its batteries, and cruises slowly at periscope depth during the day, its commander constantly scanning the sea through his periscope. When a victim is seen through the periscope (first picture) the submarine "stalks" it for a time, as is shown in the second picture.

Then the submarine commander calculates the course and speed necessary to bring his own ship into the most favourable firing position, houses the periscope, submerges to about 100 feet, and commences his "blind" approach toward his target.

After cruising the calculated number of minutes, he brings the submarine up to periscope depth again, cautiously sticks up the periscope for a final quick verification of his previously calculated data, and fires the torpedo, giving it a "lead" to allow for the target ship's forward motion through the water. If he is firing at an unarmed merchantman he may keep his periscope up to observe the effect of his shot; if at an armed target he may submerge deeply, scuttling away before he can be attacked.

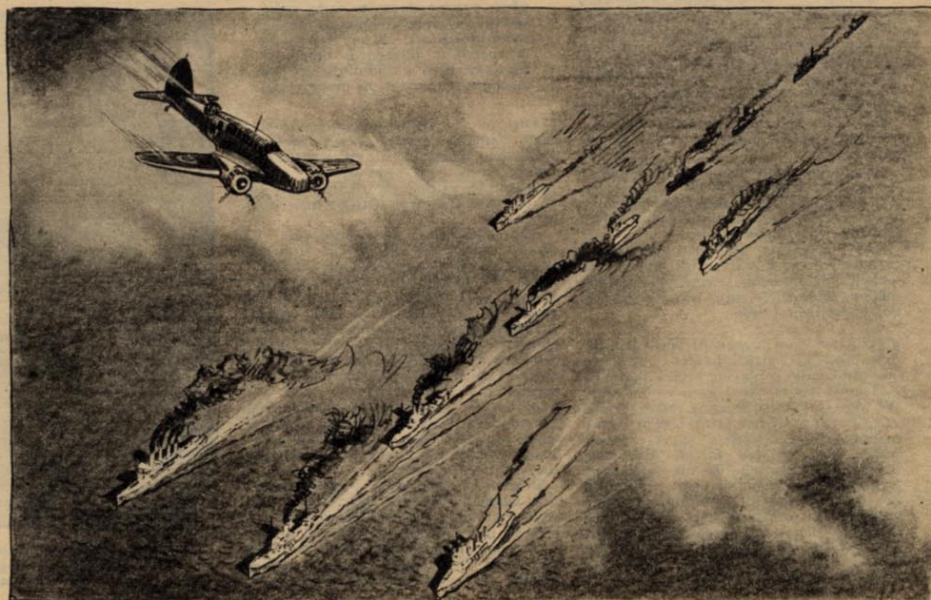
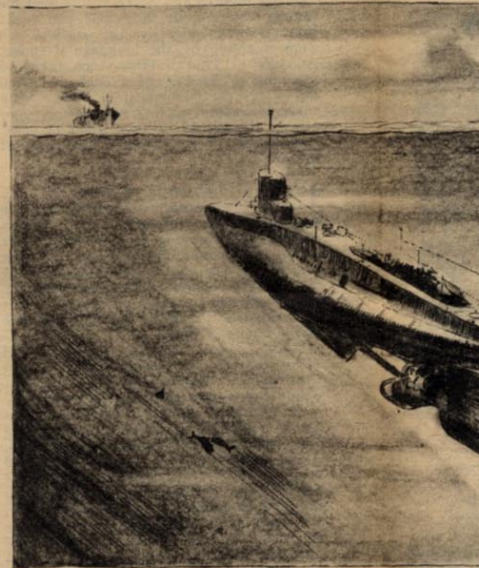
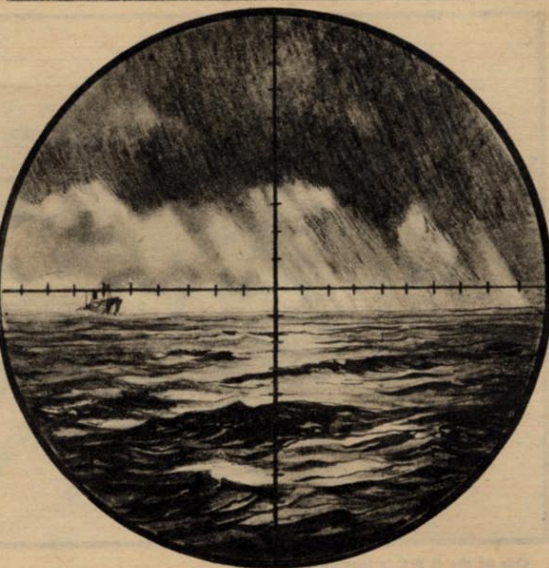
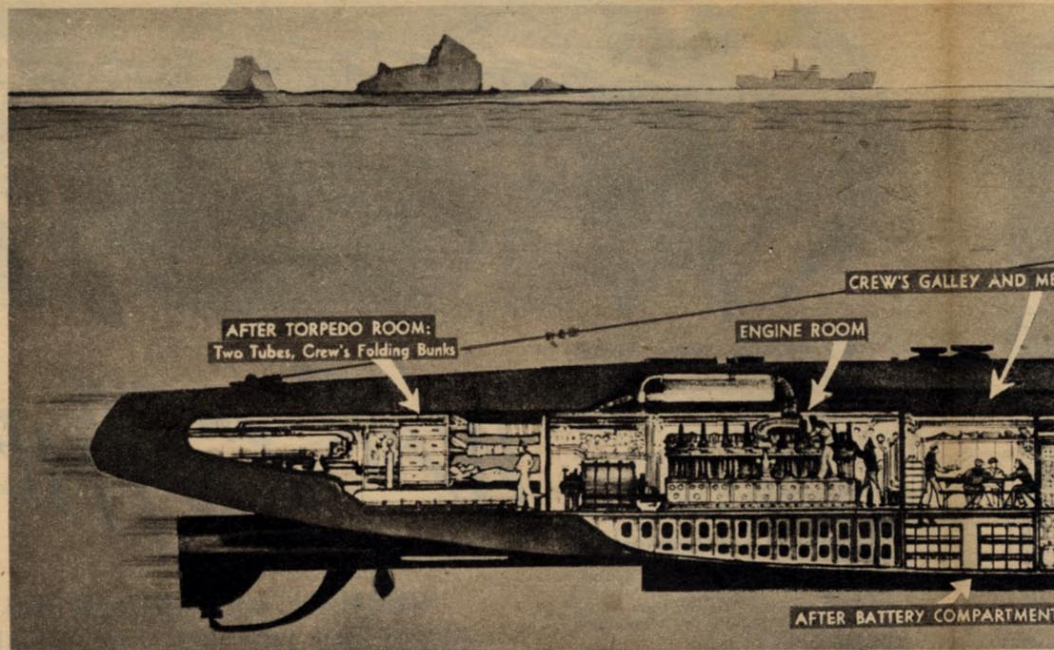
CHASING THE STALKER

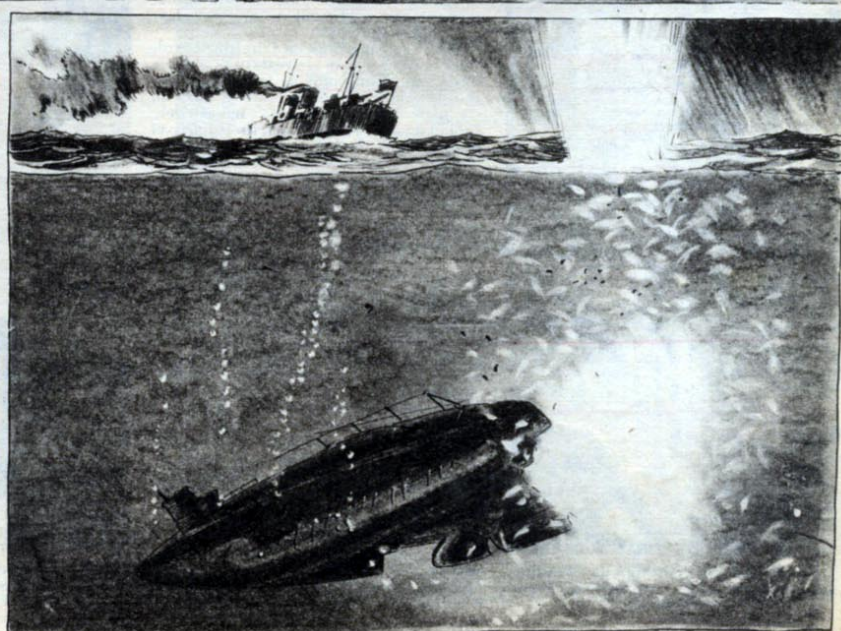
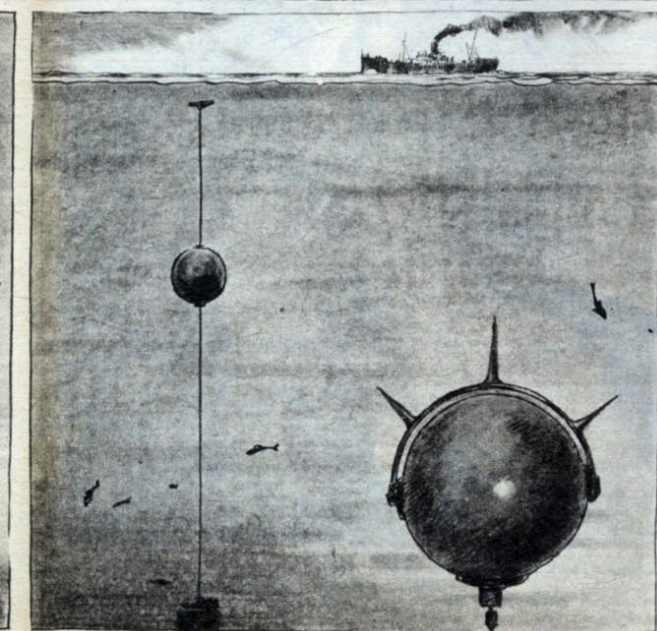
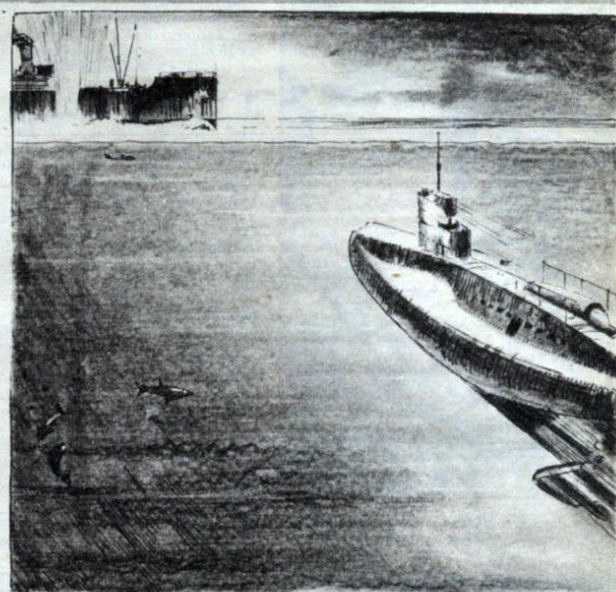
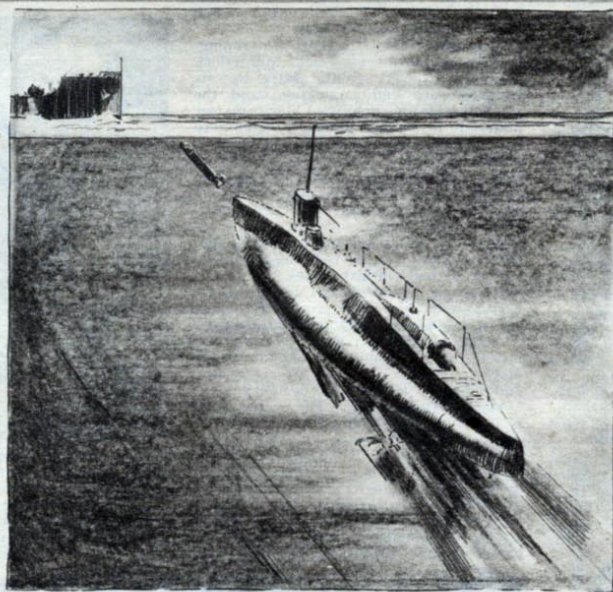
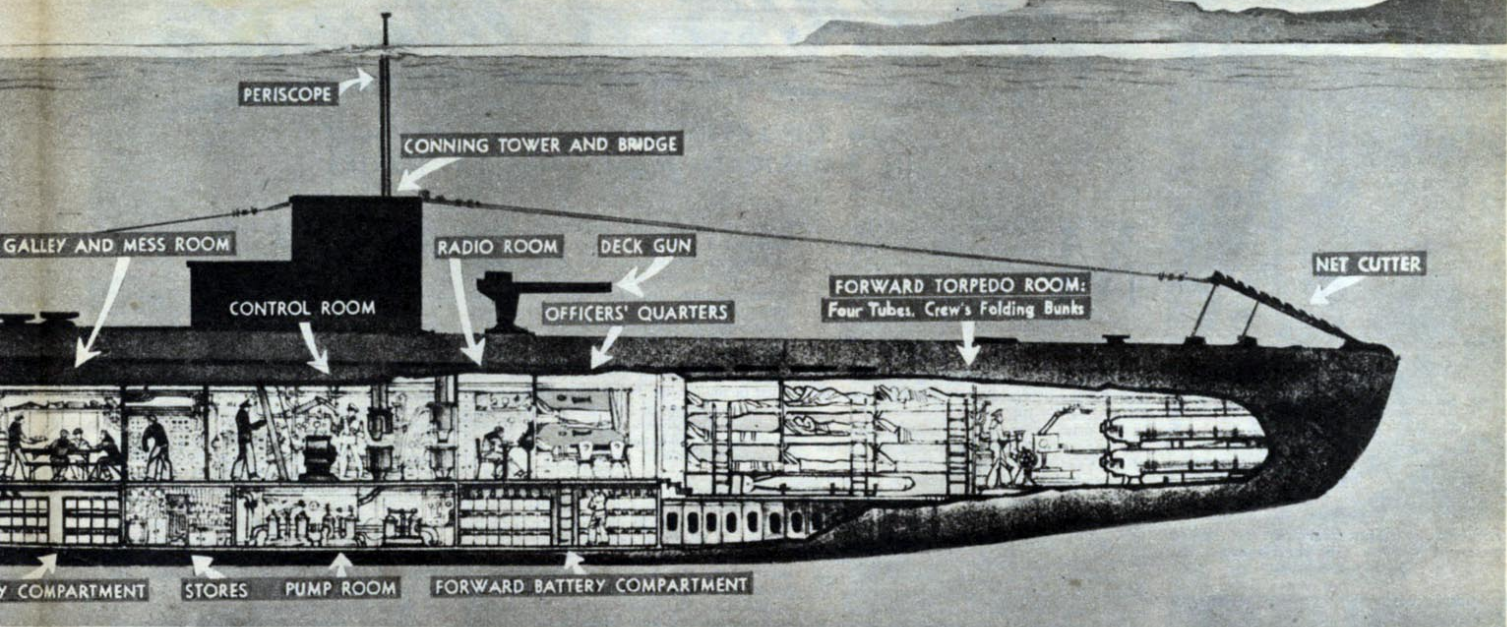
SERIES of drawings at bottom right show some of the anti-submarine methods employed in the present war. The convoy system is seen in the first picture. A group of merchant ships is herded across the seaways, generally by two or more convoying men-of-war—destroyers, cruisers, or special convoy or escort vessels. Planes precede and circle about the convoy as it approaches shore, scanning the waters for enemy submarines.

In the second picture are two types of stationary mines—anchored by the box-like weight from which the mine cable unreels, allowing the mine to float at any desired depth. The mine with the "horns" is one type—a submarine touching the "horns" will explode the mine. The other is an antenna mine, which explodes if a submarine touches the long cables above or below it.

The depth charge, water bomb, or "ash can," as it is variously known, is a favourite anti-submarine weapon of the surface ship. The depth bomb is simply a steel cylinder, loaded with TNT, which can be set to explode at any desired depth. If dropped close enough, a depth charge will crush a submarine's hull, or cause severe mechanical damage. Its effect is shown in the third drawing.

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**ROADS OF
TOMORROW**



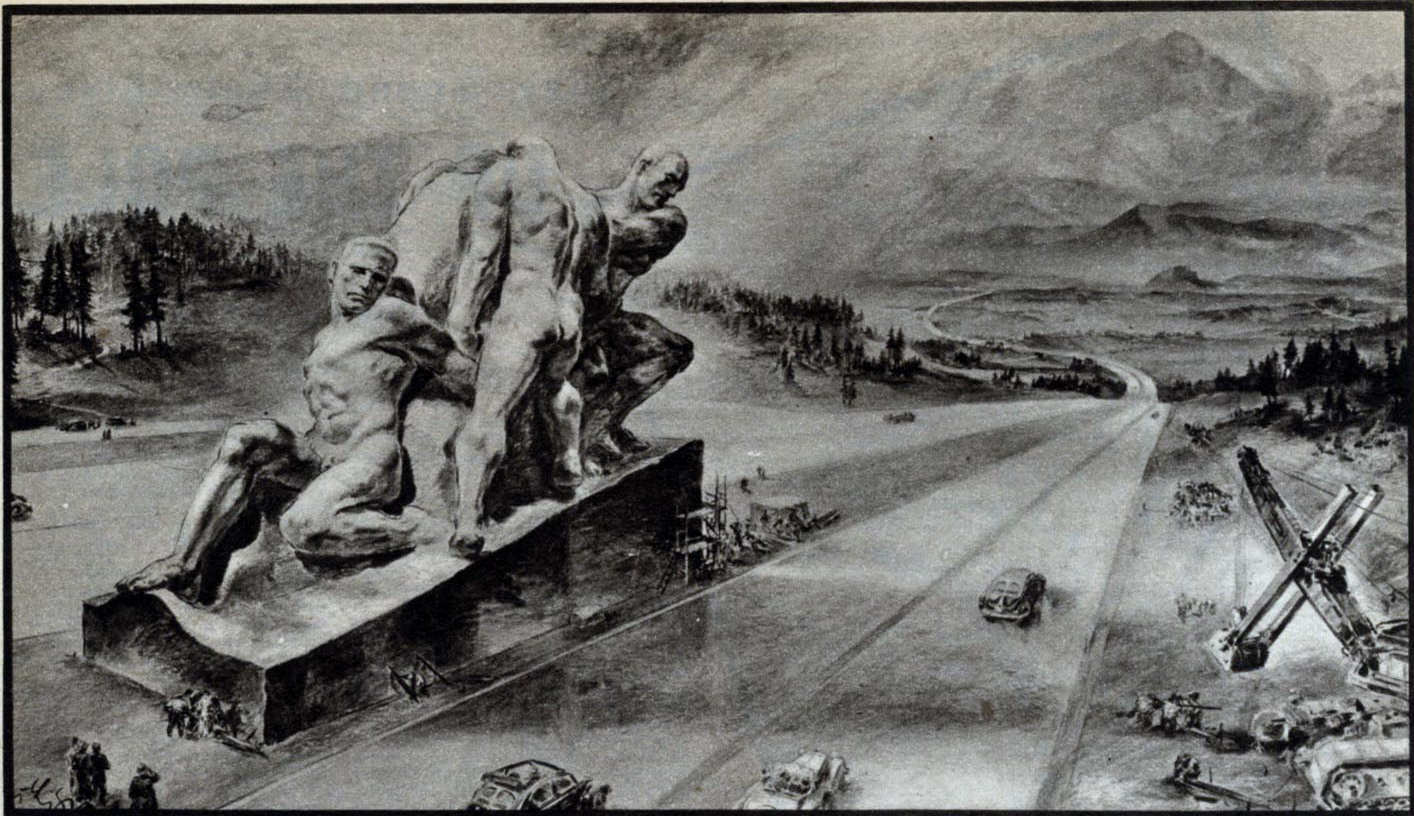
**HOW TO TRAIN
A DOG**



**THE HISTORY OF
THE TYPEWRITER**



WAR BIRDS



A NEW kind of professional man and scientific expert is coming into his own today in response to the needs of a nation on wheels.

He is the traffic engineer, most recent addition to the body of professional technical men without whom the twentieth century, fast and furious as we know it, would be an utter impossibility.

Five hundred of his kind are at work right now, thinking not so much about building roads or repairing them, but about a new job imposed by millions of motor cars: speeding traffic safely and sanely on its way. He and others are receiving their highly specialized training not only on the job, but in a number of special technical school courses.

The traffic-control engineer's concern is not with the structure of a road itself. It is with laying out the road so that traffic

ROADS OF TOMORROW

Millions of Motor Cars are creating New Problems of safety, movement and control for the Road Engineers

can move swiftly. It is with traffic signals, road markers and warning signs. He is concerned with intersections—New Jersey's famous clover-leaf intersections on main highways leading out of New York City are typical of the traffic engineer's work.

He is also very much concerned with designing curves such that cars can move around them safely at the prevailing speeds on that particular road. Control of parking is a special headache that it is his job to solve or salve. Street and highway lighting are in his province.

His field is indeed a pioneering one because it has been subjected to special scrutiny for a relatively few years. One of his jobs is to find out more about the flow of traffic: what kinds of vehicles go where, when and at what speed?

Such knowledge is indispensable to proper planning. How do the majority of accidents occur, and what percentages fall into the different categories of accidents? Such information is not yet being gathered on as wide a scale as leading highway engineers would like.

All but fifty of the five hundred traffic engineers now at work in America are employed by the government, working either for the Federal Government, the state governments or about thirty-five cities with formalized traffic-control units as part of their municipal administrations.

A traffic engineer is no policeman; in a certain sense, his job is to tell the policeman what to do about regulating traffic. With about thirty million vehicles using the streets and highways of the United States,

the traffic problem is entirely too complex to be solved incidentally to the general exercise of police power.

Emergence of the traffic engineer is one of the marks of the fourth stage of car transport's history, an expert declares.

Before it was realized that keeping cars on the move is a separate profession in itself, America passed through a stage of rapidly mounting traffic and an appalling climb in the number of car accidents: from 10,723 in 1918, the numbers rose to 27,996 in 1928 and to 38,000 in 1937.

Only then did a large number of people begin to realize a fundamental truth which many far-sighted engineers and safety experts had been hammering home for years: America was driving millions of cars designed for comfortable travel at speeds of sixty miles an hour on highways whose basic characteristics go back to a slower age and which are safe for no more than forty miles an hour.

This at least was a partial explanation of many of the mishaps which were taking (and still do take) a fatality and casualty toll reminiscent of a war.

Until this time, highway engineering was concerned almost exclusively with finding out where roads ought to go and with their construction from the surface of the road down. But this traffic problem indicated that specialized knowledge is needed to solve the problems above the surface of the road.

The organization of government street and highway agencies reflected this condition. Though they had many men expert in building and repairing highways, they had almost no

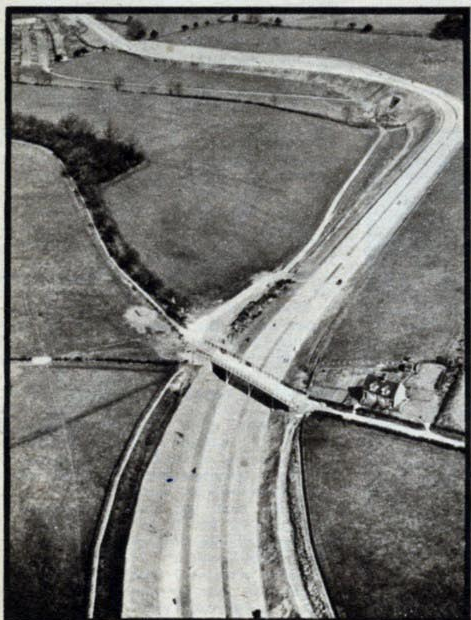
A giant statue to be erected near Salzburg as a memorial to man's work in building roads.

specialists in controlling the way the roads were used.

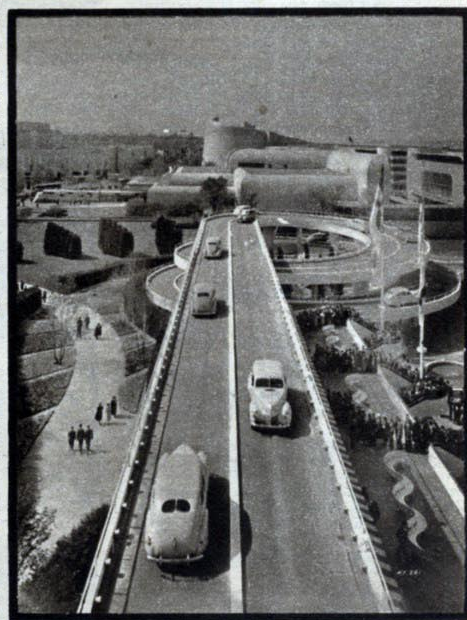
A traffic engineer is called upon to command many specialized forms of knowledge, all of which are now taught in one or more American universities.

For seventy per cent of his time, he tackles problems of mechanical control and parking, involving signs and regulations, marking signals, islands and intersections, illumination and terminal facilities. For ten per cent he works on designing new roads and planning through-traffic roads, one-way streets, zones and major street systems.

For five per cent he does traffic surveys, accident records, administration and the economics of the car. The rest of his time is devoted to problems of legislation, educating the public and enforcement.

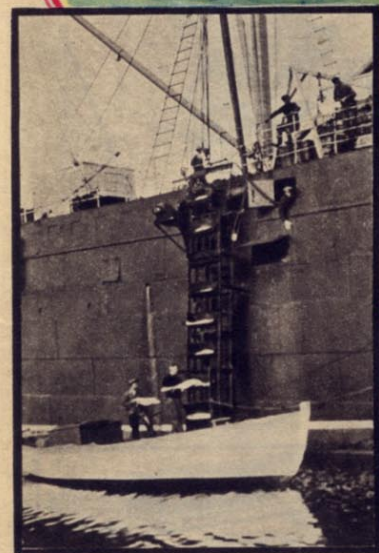


An aerial view of the new Caterham, Surrey, fly-over road which illustrates the ingenuity of man in road construction.



Thirty-six Ford cars carry visitors over the "Road of Tomorrow," where they can enjoy a wonderful view of the New York World's Fair.

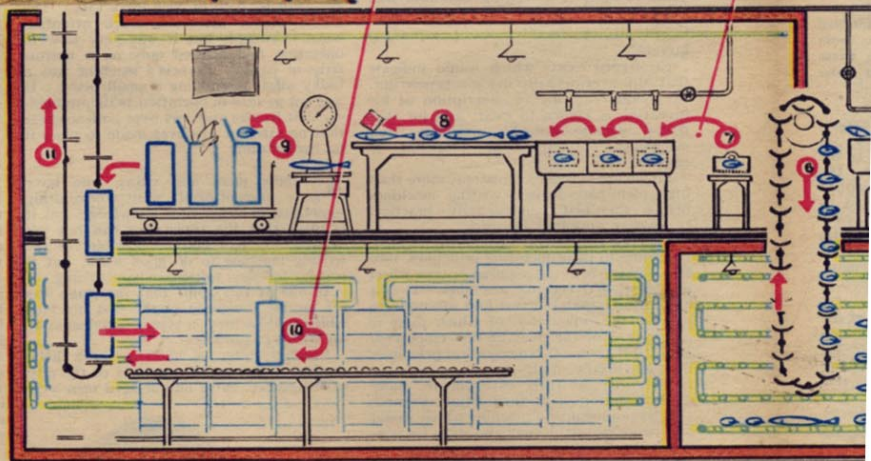
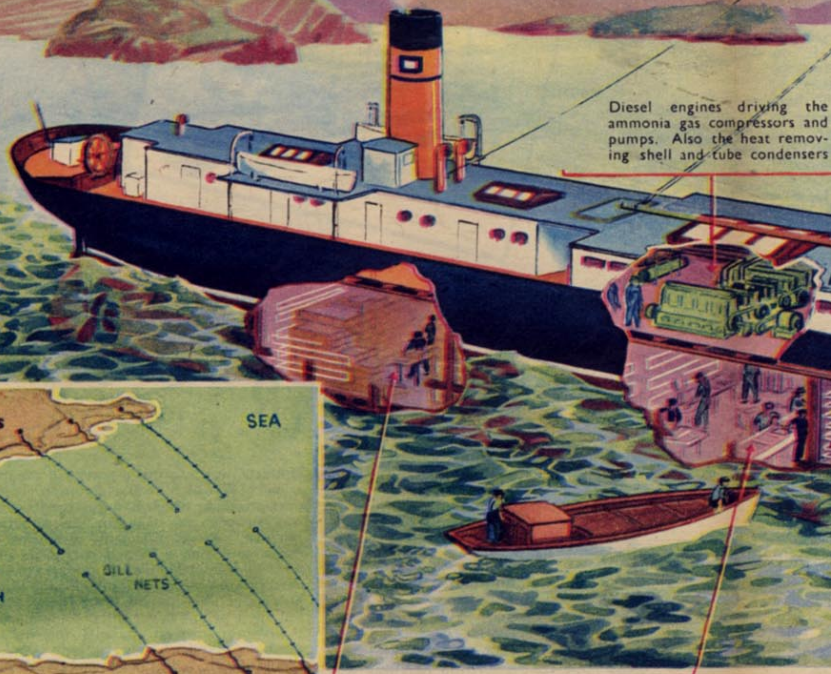
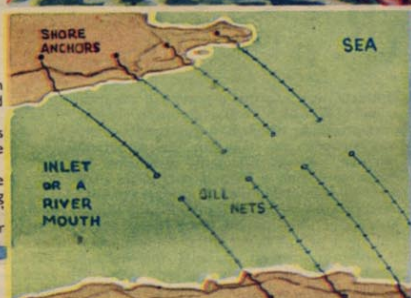
ACHIEVEMENT! - a 3000 m



The illustration on the right is a close-up of one of the cages of freezing trays loaded with salmon being lowered into the freezing tank. Some of the coils of refrigerating pipes, the agitator propeller and the device for carrying the cage out again are clearly visible in the picture
(Below) Inspecting a case of "Hubay Salmon" in this country at the port of entry



(Above) Newfoundland fishermen catching salmon in gill nets and skilfully removing them
(Right) The plan of laying nets across an inlet or bay, with one end anchored ashore
(Left) Fishermen's boat alongside "factory ship," salmon being removed from ice-filled "holds" and placed on receiving elevator



HOW to make available to the average home in Great Britain the abundant supplies of Atlantic salmon, caught along 700 miles of the sparsely inhabited shores of Newfoundland and Labrador 3,000 miles away was the problem solved by the Hudson's Bay Company, the famous pioneer trading concern (Incorporated by Royal Charter in the year 1670, for developing the fur and other natural resources of Canada).

This wonderful salmon, the true "Salmo Salar," known the world over as "the King of Fish," is of the same species as those caught in the English, Scottish and Irish rivers, and because almost identical, each fish must bear a label, approved by the authorities, to distinguish them from the protected "home caught" salmon.

The "Salmo Salar" of the Northern Atlantic does not occur in the vast quantities as do others of the salmon family caught in the Pacific and used largely for canning.

The problem, therefore, could not be met by setting up large fishery plants on shore as is the practice around the Pacific. A method much more ingenious was required, and it was decided that the most efficient plan was to create a floating refrigeration and factory plant and send it to the fishing grounds. This enabled the salmon to be frozen in the perfectly fresh condition in which it came from the fishermen's nets. Then its hygienic packing to be accomplished in the ship while travelling from point to point and its maintenance in carefully controlled cold storage, perfectly prepared for all further transport to the fishmonger.

The machinery and equipment of the Hudson's Bay Company's most recent and specially built "factory ship" and the method of freezing about thirty tons of salmon every twenty-four hours, working in two shifts, as seen in the diagram and illustrations.

In May each year, as soon as the coasts of Newfoundland and Labrador have become more or less free from winter ice, the factory ship leaves St. John's, Newfoundland, and follows up the

"run" of the salmon along the shores of the King of Fish. The salmon are caught by fishermen who gill nets stretching across the "runs" in the inlets frequented by the salmon.

The size of mesh in these nets is regulated in order to allow small and immature fish to escape. The observed is the brailing up of all nets due to enable a proportion of the run to reach the ship unhindered. Thus the continuity of supply is maintained, for it would rapidly dwindle if the fish were taken in too great numbers.

The nets are visited every few hours, and are equipped with sturdy motor boats, dories or holds, in which the salmon are placed to keep them cool on their way to the factory ship.

Arriving at the ship, the salmon are raised by an elevator consisting of a series of trays driven by an electric motor.

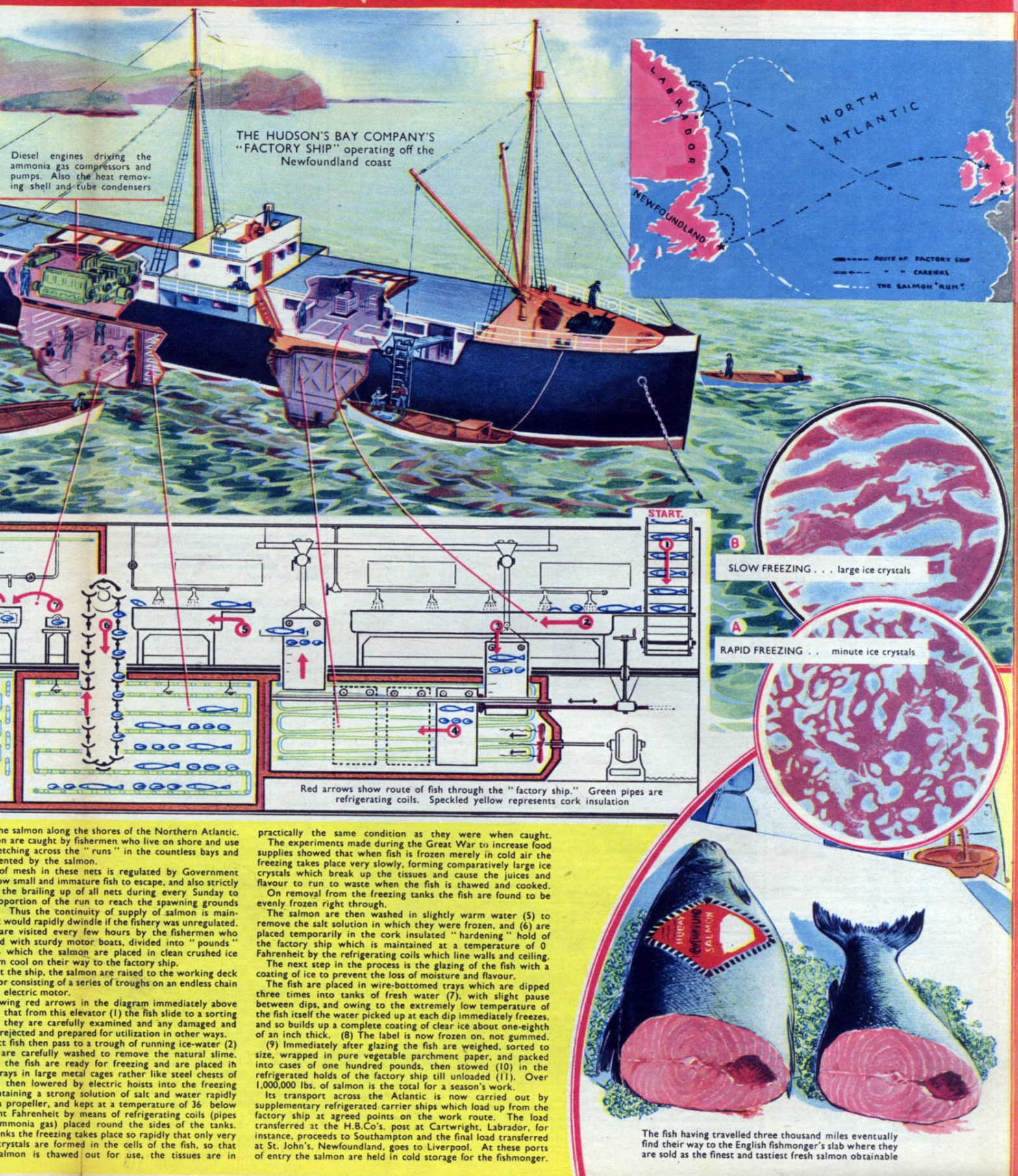
Now following red arrows in the diagram you will see that from this elevator (1) the trays where they are carefully examined, inferior fish rejected and prepared for utilization. The perfect fish then pass to a trough where they are carefully washed to remove any scales or dirt.

After this the fish are ready for freezing. They are placed in large metal cages that are lowered by electric hoists into a tank (4) containing a strong solution of agitated by a propeller, and kept at a temperature of freezing point Fahrenheit by means of a refrigerant (ammonia gas) placed round the tank.

In these tanks the freezing takes place in minute ice crystals are formed in the flesh of the fish. When the salmon is thawed out for

REX HALLUM

3000 miles journey and still FINE FRESH SALMON



Modern

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AIR DEFENCE
OF
BRITAIN

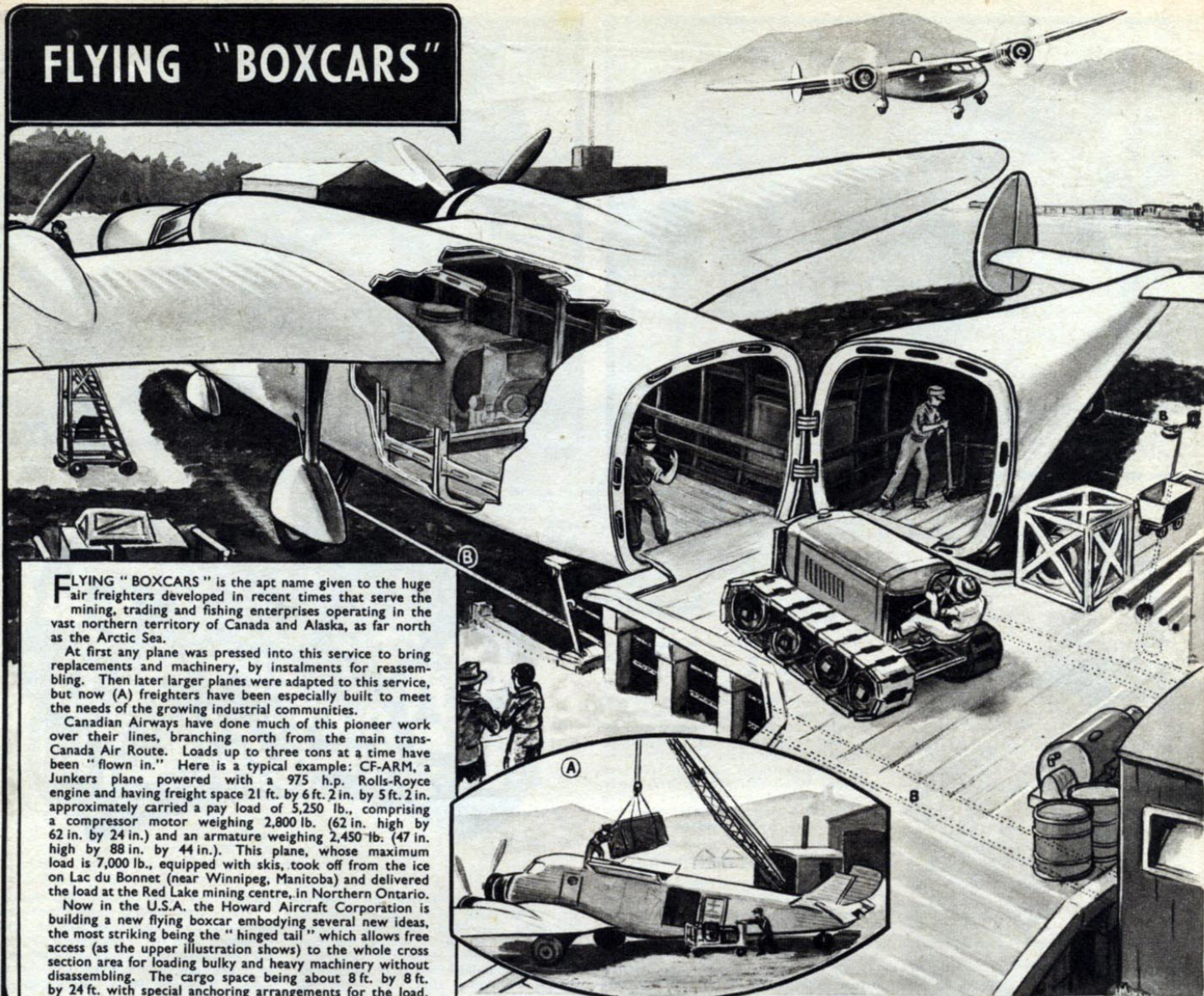


THE DEVIL TIGER



SCORPIONS OF THE SEA

FLYING "BOXCARS"



FLYING "BOXCARS" is the apt name given to the huge air freighters developed in recent times that serve the mining, trading and fishing enterprises operating in the vast northern territory of Canada and Alaska, as far north as the Arctic Sea.

At first any plane was pressed into this service to bring replacements and machinery, by instalments for reassembling. Then later larger planes were adapted to this service, but now (A) freighters have been especially built to meet the needs of the growing industrial communities.

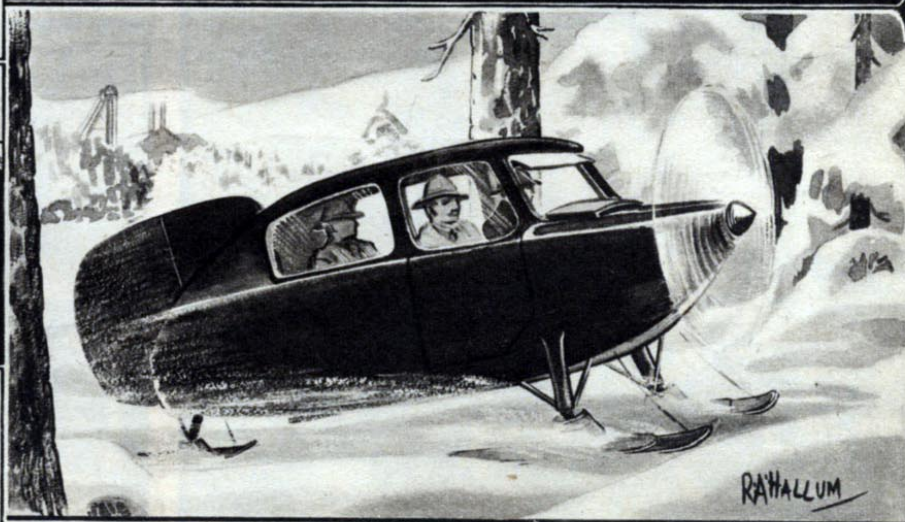
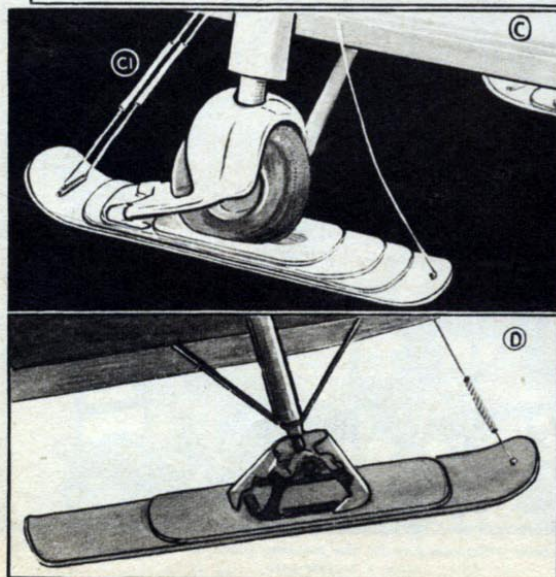
Canadian Airways have done much of this pioneer work over their lines, branching north from the main trans-Canada Air Route. Loads up to three tons at a time have been "flown in." Here is a typical example: CF-ARM, a Junkers plane powered with a 975 h.p. Rolls-Royce engine and having freight space 21 ft. by 6 ft. 2 in. by 5 ft. 2 in. approximately carried a pay load of 5,250 lb., comprising a compressor motor weighing 2,800 lb. (62 in. high by 62 in. by 24 in.) and an armature weighing 2,450 lb. (47 in. high by 88 in. by 44 in.). This plane, whose maximum load is 7,000 lb., equipped with skis, took off from the ice on Lac du Bonnet (near Winnipeg, Manitoba) and delivered the load at the Red Lake mining centre, in Northern Ontario.

Now in the U.S.A. the Howard Aircraft Corporation is building a new flying boxcar embodying several new ideas, the most striking being the "hinged tail" which allows free access (as the upper illustration shows) to the whole cross section area for loading bulky and heavy machinery without disassembling. The cargo space being about 8 ft. by 8 ft. by 24 ft. with special anchoring arrangements for the load, and a safe locking equipment for the hinged section.

This high wing monoplane, with twin radial engines (up to 1,100 h.p.) has a tricycle landing gear so that it stands level on the ground, and can be hauled backwards by wire ropes (B) to a loading platform.

To meet winter conditions these flying boxcars fit skis over their landing wheels (see C). This tremendously strong ski is made in Alberta, Canada, and allows balloon tyres to run upon it into place and then utilizes it as an added shock absorber. The spring wires (C1) lift the toe of ski.

and NORTHLAND "SNOWMOBILE"



The "snowmobile" shown proves how frequently necessity is the mother of invention. For there are quite a number now in operation in the northland. They all vary in appearance because they are made usually by the mining or oil engineers or to their order, only giving comfortable local travel in remote places, and quicker than any other form of transport. The ski utilized is as for light aeroplanes (D).

MICROSCOPY



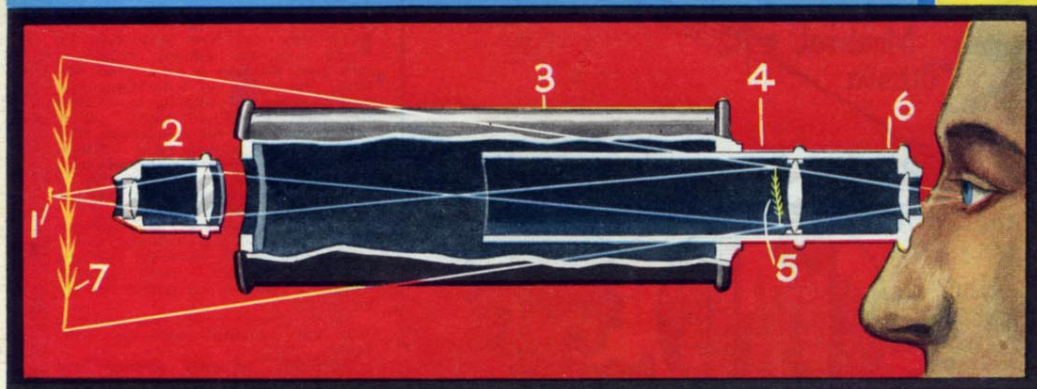
The SCIENCE OF THE MICROSCOPE

THE Science of the Microscope has enabled us to study the wonders of minute animal life that would be unknown but for the lens, and many other subjects as well. It is curious that both the telescope and the microscope were invented about the same time, the one revealing the infinitely large, and the other the infinitely small.

We attempt here to give a general simplified idea of the microscope and its wonders but the subject would take many volumes even for science.



There are many types of simple microscopes—from the ordinary hand magnifier to the simple dissecting microscope which is shown above fitted with Achromatic lens.

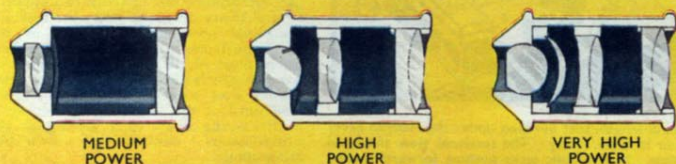


THE PRINCIPLE OF A MICROSCOPE

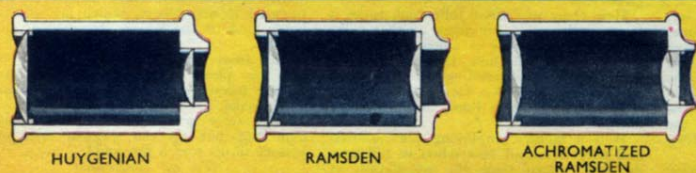
The small object (1) is magnified by the objective lenses (2), the rays passing through a body tube (3) and draw tube (4) an image being produced at (5). This is called primary magnification. The image is then further magnified by the eyepiece (6) and finally appears large as at (7).



The above sections represent the different kinds of lenses with their proper names. Convex lenses magnify—concave lenses diminish.

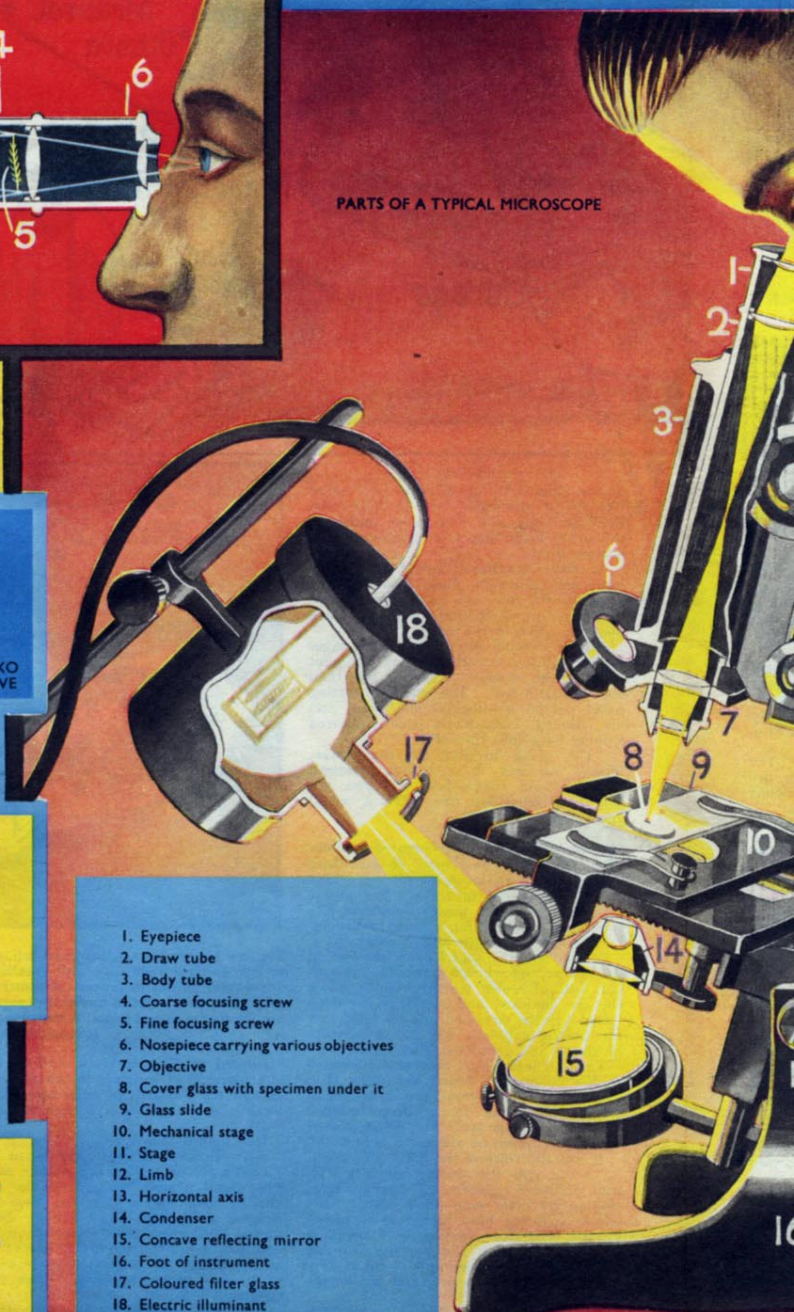


The chief function of a microscope objective is to produce the primary image as explained above. The drawings seen here show various types of objectives and the varying power of their lenses.



Eyepieces are used finally to magnify the image from the objective, and above are three types. The Huygenian type is most frequently used.

PARTS OF A TYPICAL MICROSCOPE



1. Eyepiece
2. Draw tube
3. Body tube
4. Coarse focusing screw
5. Fine focusing screw
6. Nosepiece carrying various objectives
7. Objective
8. Cover glass with specimen under it
9. Glass slide
10. Mechanical stage
11. Stage
12. Limb
13. Horizontal axis
14. Condenser
15. Concave reflecting mirror
16. Foot of instrument
17. Coloured filter glass
18. Electric illuminant

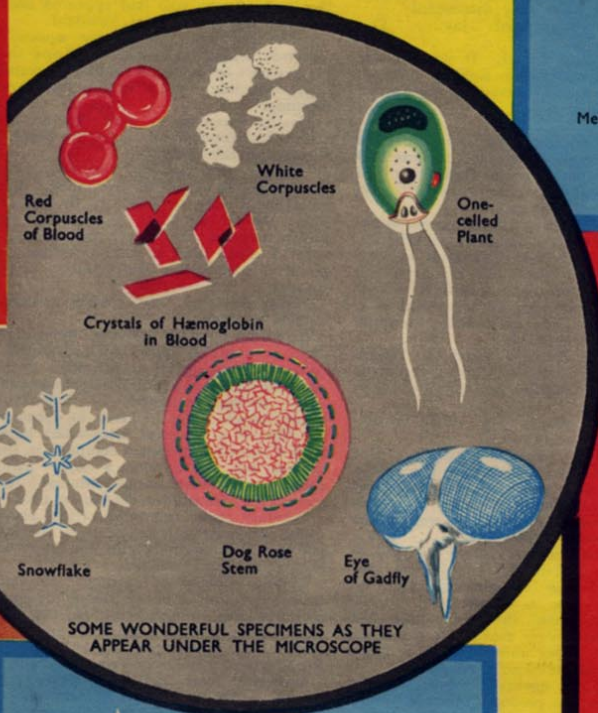
FILTER

SUBJECT

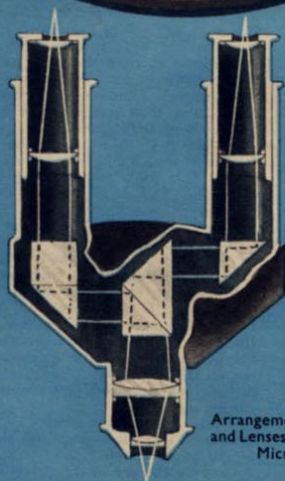


Colour filters are chiefly used in microscopy for producing greater contrast in the subject. The right coloured filters for given coloured subjects shown above.

A simple lens as shown above (left) will produce coloured fringes of the red and violet rays because they are of different foci, but by adding a flint glass as shown on right this is corrected and the lens is then called Achromatic.



SOME WONDERFUL SPECIMENS AS THEY APPEAR UNDER THE MICROSCOPE



Arrangement of Prisms and Lenses in a Binocular Microscope



Cover Glass



Blood-counting Slide



Method of mounting a metal specimen by means of plasticine

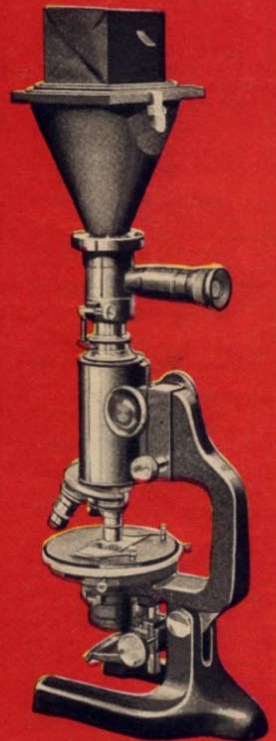
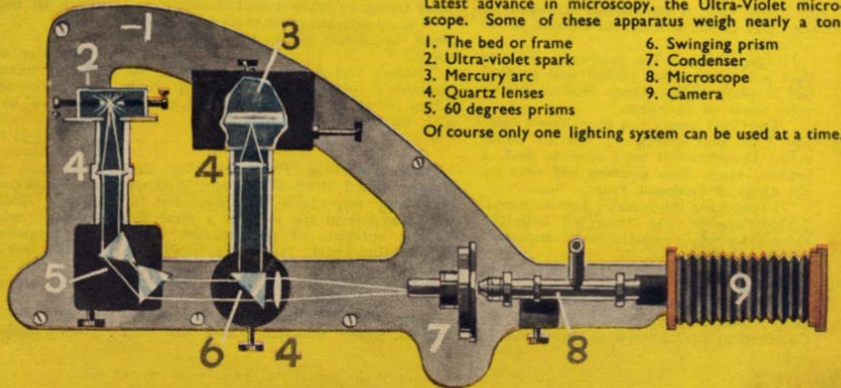
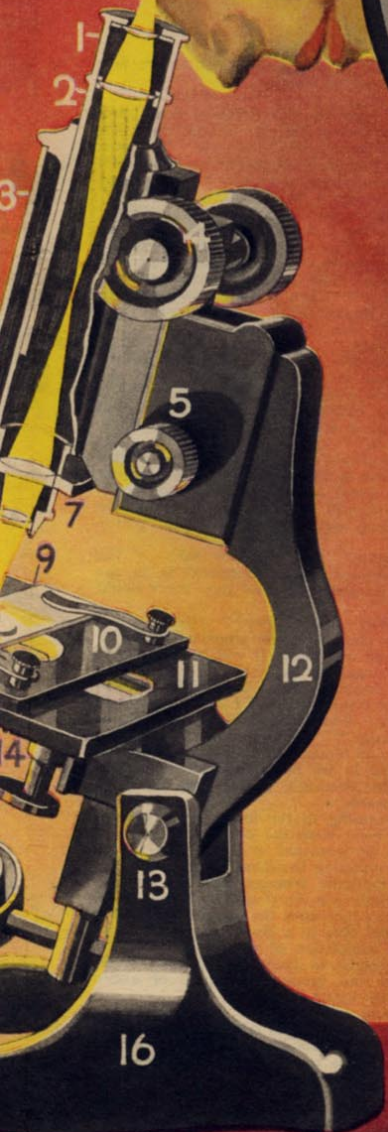


Photo-micrography, as its name implies, deals with the photography of specimens as seen in the microscope, and the instrument above is a typical example. A special camera being placed above the normal eyepiece and a projection eyepiece being used to focus by a system of mirrors to obtain permanent records.



Latest advance in microscopy, the Ultra-Violet microscope. Some of these apparatus weigh nearly a ton.
1. The bed or frame
2. Ultra-violet spark
3. Mercury arc
4. Quartz lenses
5. 60 degrees prisms
6. Swinging prism
7. Condenser
8. Microscope
9. Camera

Of course only one lighting system can be used at a time.

ASHWELL
WORLD

Modern

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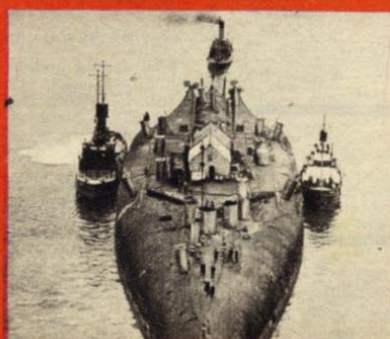
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No. 114
Vol. 5

BUILDING GIANT LOCOS



MYSTERY TRIBAL DANCE



SALVAGE



THE ROYAL ARTILLERY

Modern WONDER

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No. 110
Vol. 5



ACROBATICS WITH
THE SIGNAL CORPS



LOCOMOTIVES
"AT HOME"



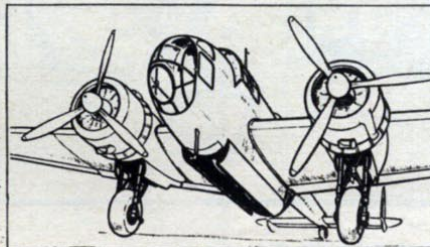
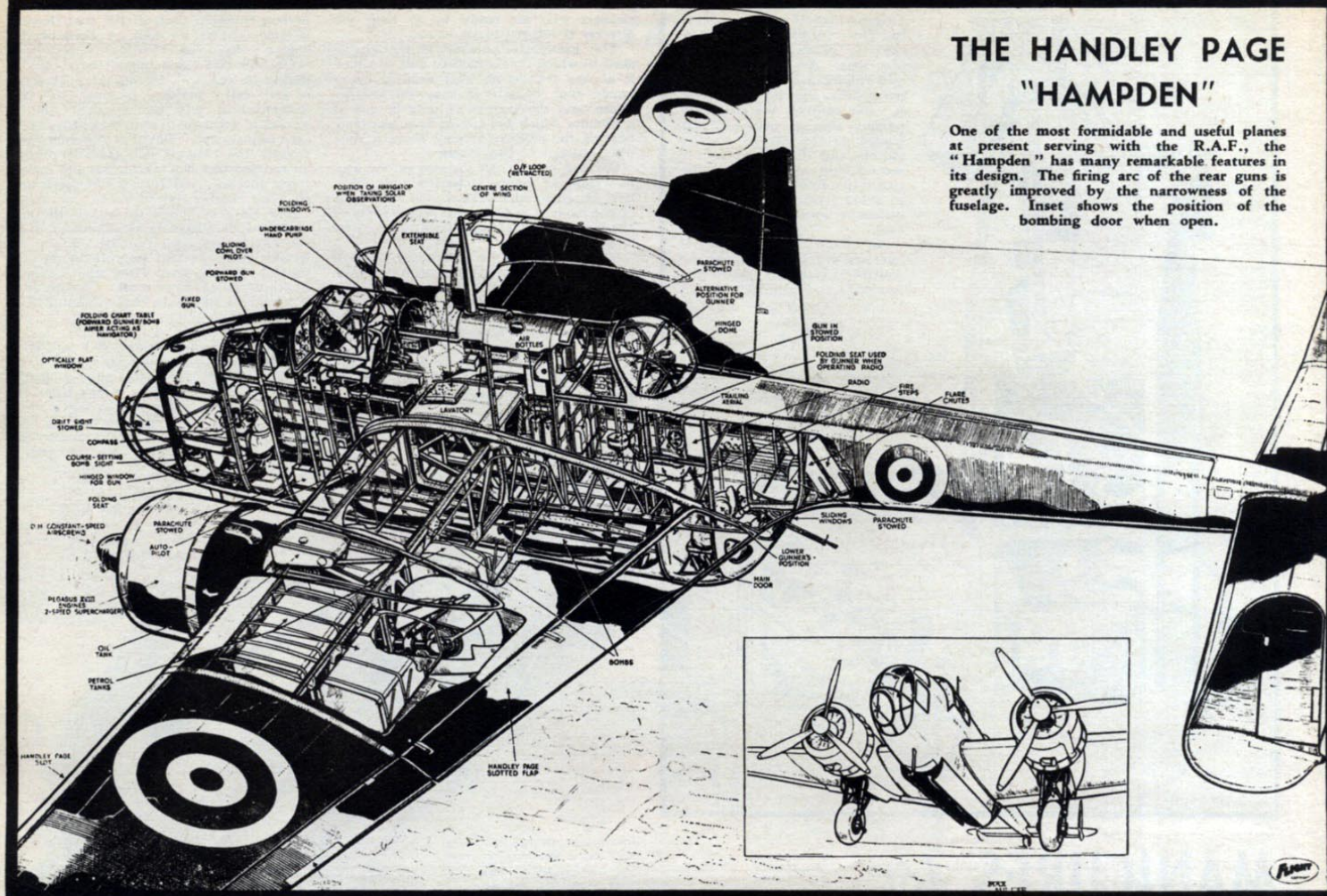
BRITISH EMPIRE
DEFENCE FORCES



THE FLEET AIR ARM

THE HANDLEY PAGE "HAMPDEN"

One of the most formidable and useful planes at present serving with the R.A.F., the "Hampden" has many remarkable features in its design. The firing arc of the rear guns is greatly improved by the narrowness of the fuselage. Inset shows the position of the bombing door when open.



A view of the "Hampden" showing the remarkable narrowness of the fuselage. The easy manoeuvrability of the plane is one of its most important features.

FAST AND FORMIDABLE

ONE of the most recent additions to Britain's already formidable bombing force, the Handley Page "Hampden" is one of the finest specimens of aeronautical engineering to be seen in any air force in the world.

It is a product of Handley Page Ltd., perhaps the company with the greatest experience in heavy bombers anywhere in the world. They have had a brilliant career with these planes, starting in the early days of the war with the "O/400." These planes were daring constructions for their day, giant machines in the days when aircraft builders were not at all sure that they would be able to get engines powerful enough to lift their planes safely off the ground.

Through the years that have ensued Handley Page have distinguished themselves with a fine series of planes that have served an invaluable purpose for Britain's defence.

The latest of their efforts is the Handley Page "Hampden."

It is a bomber built on new lines, with several unique features in its design.

One of the greatest of these is that it completely differs from many of the present R.A.F. bombers in that none of its four machine-gun posts are power operated. Three are manually operated and the fourth is fixed.

Previous Handley Page designs have been sluggish in appearance; the enormous Handley Page "Heyford" night bomber for instance; this giant biplane was capable of a remarkably high speed for a plane of its size and time, but its appearance hardly seemed to bear out this fact. The "Hampden" is different here. Apart from being designed as a bomber with an excellent performance it is prepared for mild duties as a fighter, an innovation that has been adopted with many present-day bombers.

The plane is a three-four seater usually carrying a crew of pilot, who also operates the fixed gun, bomb aimer, operating front and lower gun, wireless operator, who manipulates the upper rear gun, and a gunner for the lower rear position.

With a crew and equipment of this size

the "Hampden" is one of the most formidable planes that is ever likely to go on a bombing raid.

Its twin engines are Bristol "Pegasus XVIII," radial engines which give it a maximum speed of 265 miles per hour. Alternative engines are Rolls Royce "Merlin X's" or Napier "Dagger VIII's."

The pilot is situated in a high position giving him a completely unobstructed view in front and to the sides of the plane. The rear is looked after by the two gunners.

The three gun turrets are uniquely situated. The front bomb aimer's and gunner's position is rather similar to that of the Bristol "Blenheim." The two rear gun turrets are placed almost one above the other where the trailing edge of the wing joins the fuselage.

Another familiar feature about the plane that points it out as of Handley Page design is the narrow fuselage. At its widest point it only measures three feet. This is noticeable in nearly all previous constructions especially with the "Harrow."

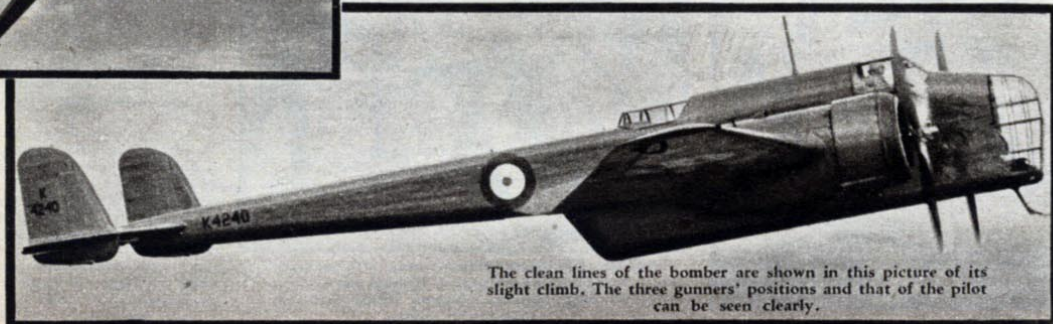
The "Hampden" carries a useful load of 6,976 lbs. and cruises at 217 m.p.h. at 15,000 feet. The service ceiling is 22,700 feet and the rate of climb at sea level 980 feet per minute. Landing speed is seventy-three miles per hour.

The range of the plane varies considerably according to the load carried. Carrying a load of 2,587 lbs. the range at cruising speed is 1,475 miles, while a load of 5,587 lbs. reduces this to 360 miles at cruising speed.

These ranges are improved however if the plane is operating at maximum possible weight of 21,000 lbs. because of the added amount of fuel carried.

Taken as a whole the Handley Page "Hampden" is a remarkable plane, and a welcome addition to an already strong Royal Air Force.

B.S.M.



The clean lines of the bomber are shown in this picture of its slight climb. The three gunners' positions and that of the pilot can be seen clearly.

Modern

WONDER

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THE STORY OF THE AIR CADETS

*Britain's "Boy Scouts"
of the Sky Trails*



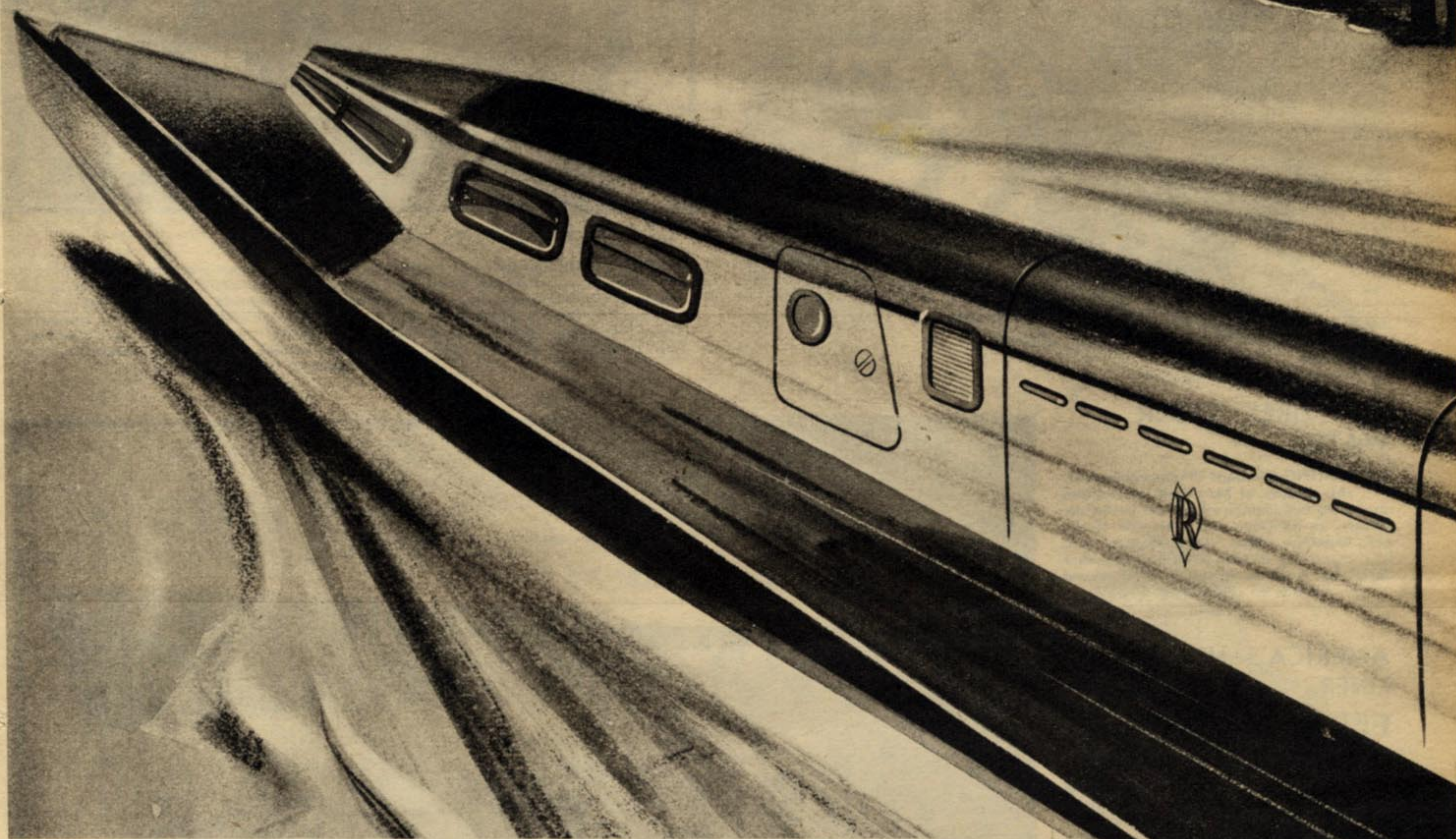
LEARNING TO BE SAILORS



THIS GUN CAN FIRE UNDER WATER

**"Modern Wonder's"
Great Birthday
Presentation**

THIS AMAZING HIGH SP



CUT HERE. DO NOT SEPARATE FORM AND LABEL.

"MODERN WONDER" BIRTHDAY CELEBRATION

SEND NO MONEY WITH THIS FORM

"Aqua-Hurricane" Hydroplane

RESERVATION FORM

Address your envelope exactly as shown below and post to

Model Presentation (Dept. M.H.), 39 Earlham Street,
London, W.C.2. (Pref.)

This Form reserves an "Aqua-Hurricane" Hydroplane in your name.

Please reserve in my name an "Aqua-Hurricane" Hydroplane,
and send me my Official Privilege Voucher which entitles
me to obtain it at the Birthday Celebration Privilege Price.
I am a regular reader of "Modern Wonder" and will
continue to take it regularly.

Signature

Write clearly below in BLOCK LETTERS.

Full Postal
Address

Date

Last day for receipt of these Forms is Wednesday, June 14.

This offer applies only to residents in Great Britain, Northern Ireland and Eire.
Applicants in Eire will be required to pay any charges that may be levied. Mod.Wonder 10/6/39

The Label on right
will be used for
sending you your
Privilege Voucher.
It MUST bear a
halfpenny stamp
and be filled in with
your name and
FULL POSTAL
ADDRESS, very
clearly written in
BLOCK LETTERS.
This Reservation
Form with Label on
right may be posted
in an unsealed en-
velope bearing a
halfpenny stamp.

A
Halfpenny
Stamp must
be firmly
affixed here
by you.

NAME

FULL POSTAL ADDRESS

M.W.H.

POST FORMS

SEND HYDROPLANE FOR EVERY READER!



A
FULL-SIZE
MODEL
OVER
2 FT.
IN LENGTH

No tokens to collect!
You send no money now!

HIGH SPEED MODEL WATER-CRAFT AT ITS BEST! A gleaming, streamlined racing craft over TWO FEET IN LENGTH. A scientifically-planned model built on the ultra-modern design of the world's fastest Hydroplane, the only model of its kind, the largest, fastest and finest looking model water speed-craft ever produced—the "AQUA-HURRICANE." That is the remarkable presentation which "Modern Wonder," to celebrate its second birthday, invites every one of its readers to accept. Here is no toy, but a lifelike replica of the real thing, a unique model which you would consider worth every penny of 12/6, yet "Modern Wonder" makes it available to you for only 2/10, POSTAGE PAID. But you must apply immediately. Supplies of these models are strictly limited. All applications will be dealt with in strict rotation. THERE ARE NO TOKENS TO COLLECT AND YOU SEND NO MONEY NOW. Simply fill in and post the Reservation Forms on the opposite page today. Do it at once.



You have never seen anything more thrilling than the "Aqua-Hurricane." Every line indicates lightning speed and power. Its design is revolutionary—an absolutely NEW IDEA evolved after long months of experiment by Britain's most famous designers.

Passed Every Test

The "Aqua-Hurricane" has passed every test and the speeds attained are nothing short of sensational. You'll be amazed at its performance—your friends will be thrilled beyond words when they see this wonderful Hydroplane in action. Its "get-away" velocity is terrific—and the acceleration to top speed in a split second sends the "Aqua-Hurricane" flashing away so fast that the nose of the craft rises from the water, with the stern skimming the surface of the water for

ONE HUNDRED AND FIFTY FEET OR MORE in a straight or sweeping circular course!

Another Big Thrill! YOU ACTUALLY BUILD THE "AQUA-HURRICANE"—YOURSELF! It's as simple as A.B.C. to put together—there are only seven parts to assemble—you just can't go wrong—everything is so easy that you can build the "Aqua-Hurricane" without special tools and without help—in record time.

Just think of the extra thrill of assembling your own "Aqua-Hurricane"—how proud you will feel to know that your wonderful Hydroplane was BUILT BY YOU!

And now for some of the outstanding features of this remarkable Hydroplane:—



All-metal tri-blade Propeller

—one of the secrets of the Hydroplane's remarkable performance. It is all-metal and is securely mounted on the stern above the water level.

Streamlined Hull The hull of the "Aqua-Hurricane" alone is nearly TWO FEET in length, it is made of strong Aqua-board, perfectly streamlined to reduce water and air resistance to a minimum, and is powerfully reinforced to withstand extreme water pressure at high speed. Cabins, observation panels, a control cockpit, etc., are all indicated on the brilliantly coloured hull. With your Presentation "Aqua-Hurricane" is provided a generous supply of special varnish to give a gleaming finish to your speed-craft.



Twin-band Motor A twin band of specially selected rubber drives the three-blade airscrew. The motor band is of exceptional length and strength, and can safely be given six hundred to seven hundred turns, thus providing a tremendous reserve of power to drive the "Aqua-Hurricane" remarkable distances at marvellous speed.

Just think of it! MODERN WONDER's magnificent Birthday Presentation to YOU is no ordinary Hydroplane, but the only MODEL SPEED-CRAFT OF ITS KIND EVER DESIGNED!

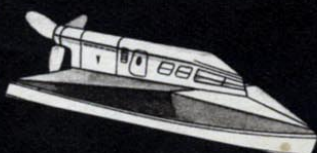
NOW read on and see how easy it is to get this "Aqua-Hurricane" Hydroplane.

DO THIS NOW

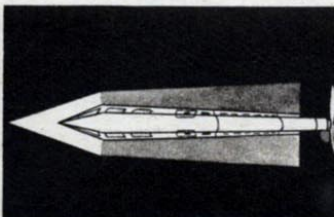
Simply fill in your name and address on the Reservation Form and Label on the opposite page, certifying that you are a regular reader of "Modern Wonder." Send both Forms at once. This reserves and guarantees your Hydroplane in your name. A halfpenny stamp must be affixed to the Label. Upon receipt of your completed Forms, you will be sent your official Privilege Voucher entitling you to receive the Hydroplane on these unique Privilege terms. You then send your remittance of 2/10 and your Hydroplane will be dispatched, postage paid, to your home.

ACT TODAY. Seize this birthday opportunity now, while it's before you. Don't be too late. Remember, the demand for the strictly limited supply of these models will be tremendous. There are no Tokens to collect. It's first come—first served. Complete and post the Forms on the opposite page NOW!

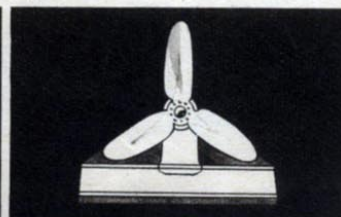
ON LEFT AT ONCE!



THREE-QUARTER FRONT VIEW
One of the secrets of the "Aqua-Hurricane's" astonishing performance is its perfect, ultra-modern streamlining. Here you see the magnificent hull of the Hydroplane, which offers a minimum of resistance to wind and water when "all out."



AERIAL VIEW
Here is the "Aqua-Hurricane" as seen from above skimming across the water, its TRI-BLADE Airscrew ripping the surface of the water as it revolves at terrific speed.



END VIEW
See how simply the unique Tri-Blade Airscrew motor unit is mounted on the stern of the Hydroplane. This Airscrew, which has been specially designed for the "Aqua-Hurricane" is ALL METAL.

AMBULANCES of the SEA



A forty-five-foot-long motor-lifeboat coming over the crest of a wave with only half her length in the water.

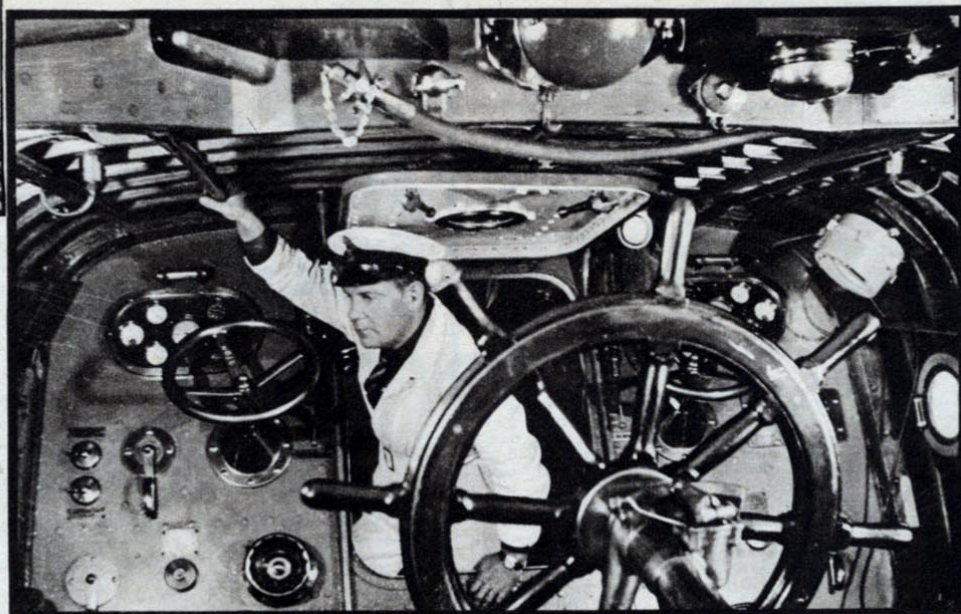
FEELING its way blindly as the fog swirled around it, the tramp steamer ploughed through the water, punctuating its progress with the wail of its siren. Somewhere in the vicinity was a rugged coastline; great towers of uprising rock, stretching out sharp teeth to lure the unsuspecting ship to a watery doom.

Until Lionel Lukin, an English experimenter living at the time when George IV was Prince of Wales, patented what he described as an "unimmergible" boat, every seaman dreaded the hidden danger of the lonely coastline that might leave him helpless, at the mercy of savage nature.

This earliest type of lifeboat got its buoyancy by having at each end a projecting gunwale of cork, with air chambers inside, and its inventor was associated with the earliest life-saving service when it was established by Archdeacon Sharp at Bamborough in 1786.

The first real public interest in life-saving at sea was stirred through the wreck of a ship at the mouth of the River Tyne in 1789. Although only three hundred yards from the shore, and watched by thousands of spectators, everyone was helpless to assist the members of the crew as they dropped into the raging sea.

At that time, prizes were offered by citizens of a nearby town for the best



The exterior of modern lifeboats have become a common enough sight, but the interior is still not really well known. This picture was taken inside the new Gorleston lifeboat. The boat cost £9,000 and is the last word in modernity.



The bow of the lifeboat falls vertically and hits the surface of the water with a tremendous shock.

The crews of the motor vessels are usually from six to eight, but thirteen to seventeen are necessary in the other types of boats.

The principle upon which the lifeboat operates is that if a boat is made in the form of a quarter of a spheroid it will always right itself in water. That method of construction is adopted to prevent it from turning turtle, but there are also certain other points which have to be allowed for in the design.

Buoyancy, stability and self-emptying powers are essential in any boat which has to brave the elements of nature at their worst, and for this reason a heavy iron keel is fitted, and air-cases placed round the sides of the boat as well as two large air-chambers fore and aft.

The self-emptying system is obtained by having the floor of the boat above the water-line, and having a number of large holes, at the upper end of which valves are fitted that allow water to come out but not in. The tests to which a new boat are submitted include ability to right itself when fully loaded, and with anchor down, a very searching test.

A problem which is met on some parts of the coast is caused through the lifeboat having to be launched from a boat-house some distance from the sea. In this case a carriage is used to carry the boat, and the work of launching the lifeboat to aid a ship in distress is often a job that is done by nearly the whole of the able-bodied inhabitants of the village.

design for a lifeboat, and William Would-have submitted plans for a boat that would right itself if capsized. From a combination of this design and a number of others, the *Original* was built, and this, the first real lifeboat, saved hundreds of lives during its years of service up to 1830.

In 1824 the Royal National Lifeboat Institution was formed, and soon became to be acknowledged as one of England's finest charitable societies. Although it started with little finance it soon had twelve new lifeboats round our coast, in addition to thirty-nine already established through the generosity of private individuals.

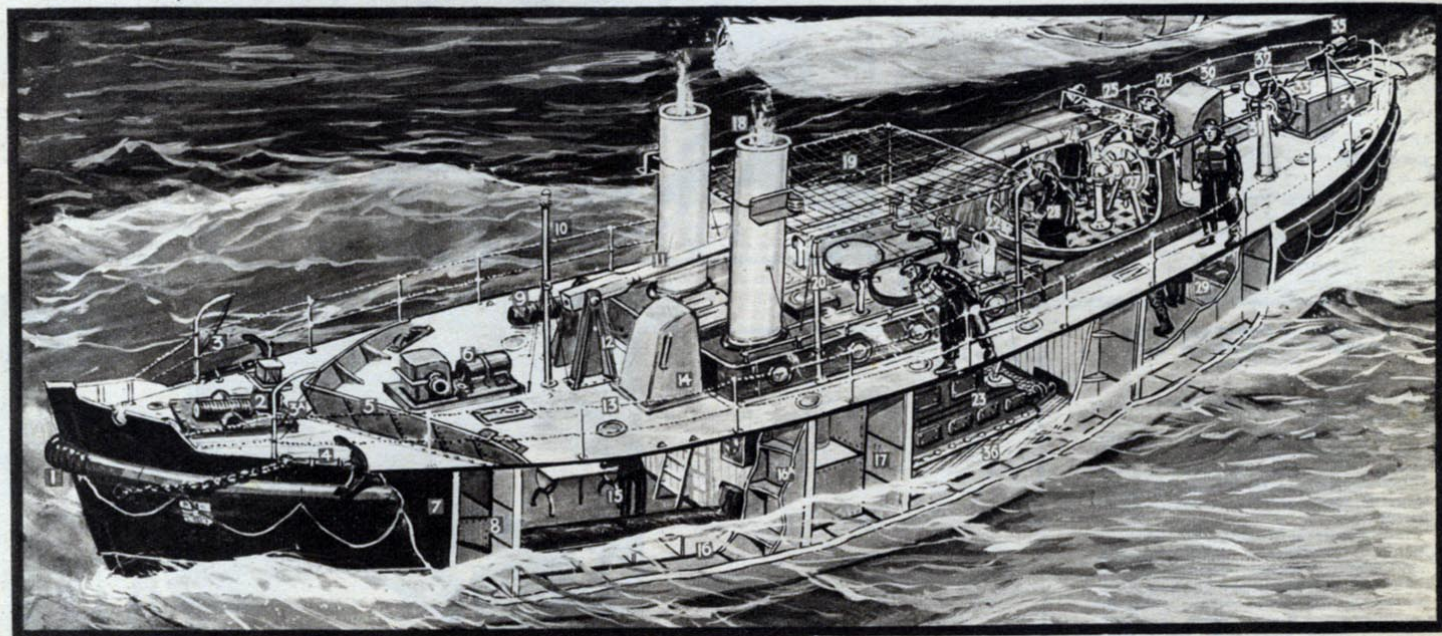
The year 1890 saw new developments in lifeboats, with the advent of the Watson Lifeboat which was especially suitable for going far out to sea. At the same time a steam lifeboat was stationed

at Harwich. But with the development of the internal-combustion engine experiments were made in 1903 to adapt it to the particular requirements of the lifeboat.

With the successful design of a motor-lifeboat greater range and more facilities were added to the work of the Institution. Such additions to the equipment of the boats as searchlights, and nets into which the crew of a distressed ship could jump, were now available in the more powerful boats, and the work of saving lives at sea greatly assisted.

All round the English coast these life-saving stations are manned by volunteer crews who hold themselves always in readiness to battle against the grim forces of nature to aid their fellow men in distress.

Every three months the pulling and sailing lifeboats are launched for exercise and practice, and each month the motor-driven boats are thoroughly tested in the water.



61 ft. TWIN-SCREW MOTOR-LIFEBOAT (crew 8).—1, Bow fender; 2, Towing bollard; 3 and 3a, Anchor davits; 4, Port anchor; 5, Breakwater; 6, Capstan; 7, Forward watertight compartment; 8, Fresh water tank; 9, Sails (stowed); 10, Steaming light; 11, Mast lowered; 12, Mast support; 13, Deck; 14, Forward cabin companion way; 15, Forward cabin; 16 and 16a, Flotation boxes along sides; 17, Fuel tank; 18, Twin funnels; 19, Jumping net (men from ship in distress leap from the deck of their own ship into this net); 20, Engine room hatch; 21, Reserve anchor; 22, Vents; 23, Port 80 b.h.p. motor (there are two, both can work submerged); 24, Shelter (diagrammatically cut away); 25, Wind screen; 26, Coxswain; 27, Binnacle; 28, Engineer at motor control wheels; 29, After cabin; 30, Companion way to after cabin; 31, Steering shaft; 32, Searchlight; 33, Reserve steering wheel; 34, Steering gear casing; 35, Line-throwing gun (life-line coiled in box over barrel); 36, Surface or sea level.

Modern Wonder

Vol. 4, No. 94, Week ending March 4, 1939

TWOPENCE
EVERY WEDNESDAY

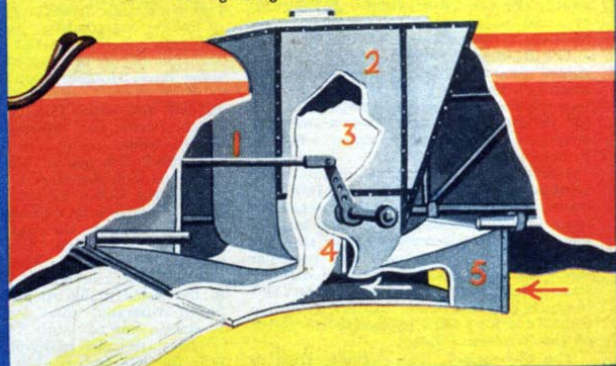


AIR RAIDS ON INSECTS

DETAILS OF THE HOPPER

The powder is sucked out by air rushing through the funnel-shaped scoop beneath the hopper.

1. The pilot's control rod 2. Hopper 3. Calcium arsenate powder 4. Regulating valve 5. Air inlet



AEROPLANES dropping powder to overcome plagues which threaten crops and trees are being used increasingly. The American cotton boll weevil is one of the most dangerous insects, and before the aeroplane came to the rescue the estimated damage done to the cotton crops in some years amounted to £200,000,000. This insect ruined thousands of farmers and drove merchants out of business.

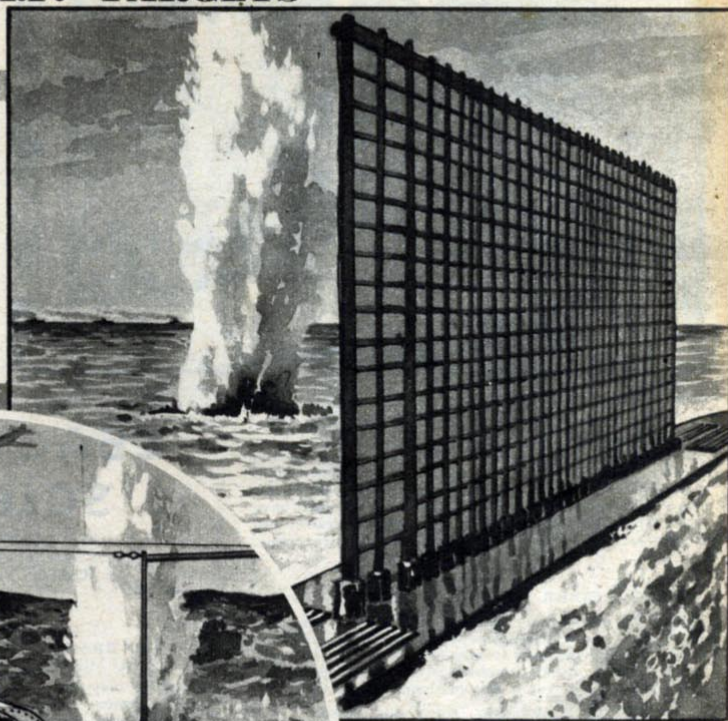
The Autogiro aircraft shown here is dusting a cotton crop with calcium arsenate to kill the boll weevil—this is generally done in the early morning and again in the evening. The powder is carried in a hopper as described above. One aeroplane can dust 1,000 acres in an hour which under the old system took the work of seventy-five carts. The large American plantations are particularly suited to the aeroplane method. About three pounds of powder are used per acre but frequent stops have to be made for refuelling. The back-draught of an aircraft forces the dust downwards on the crops, which is a great advantage.

Aerobatic flying is sometimes necessary to cover difficult corners of fields.

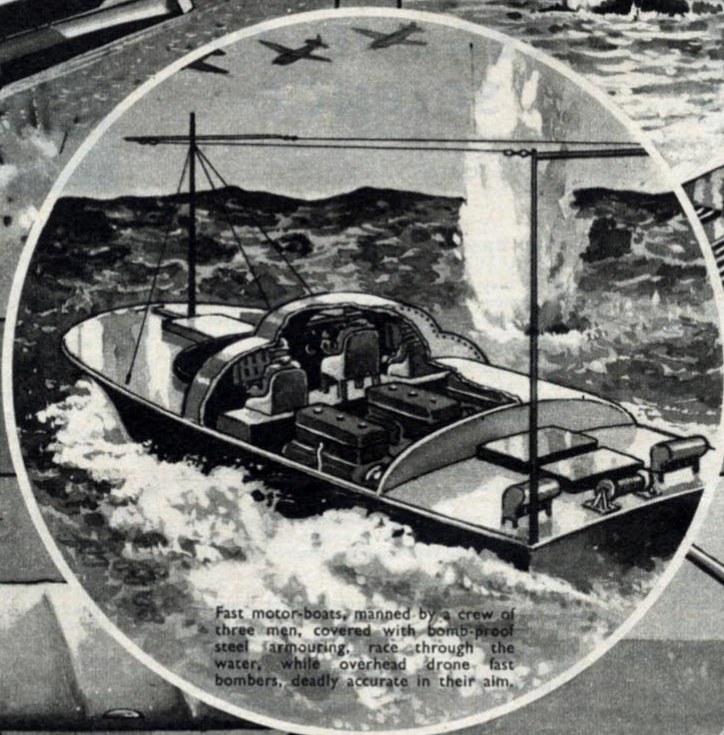
NAVAL AND R.A.F. TARGETS



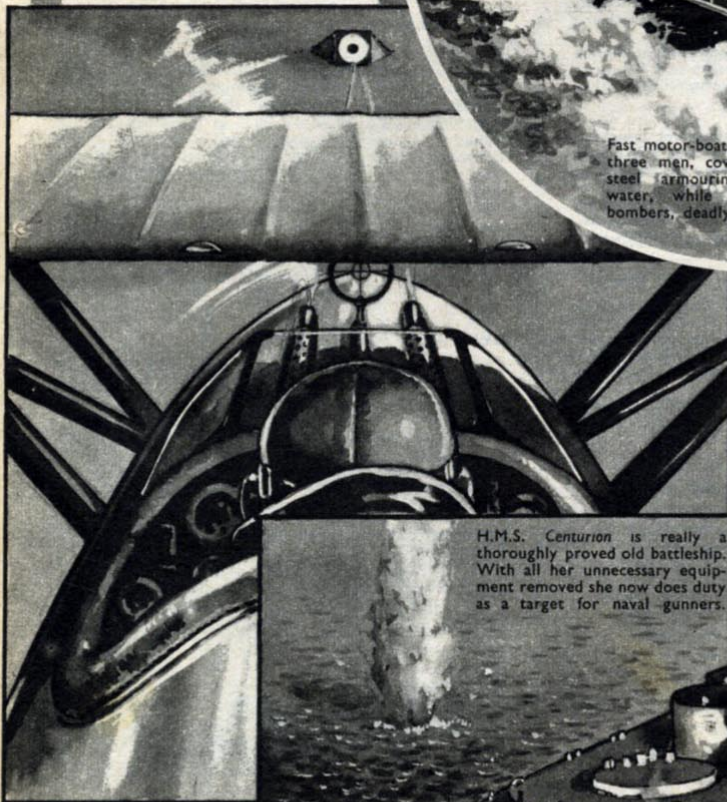
The radio-controlled Queen Bee. This wonderful plane plays an important part in naval exercises; many times has she been hit by shells, but she is still doing her duty. Flying high, this pilotless plane is no easy target.



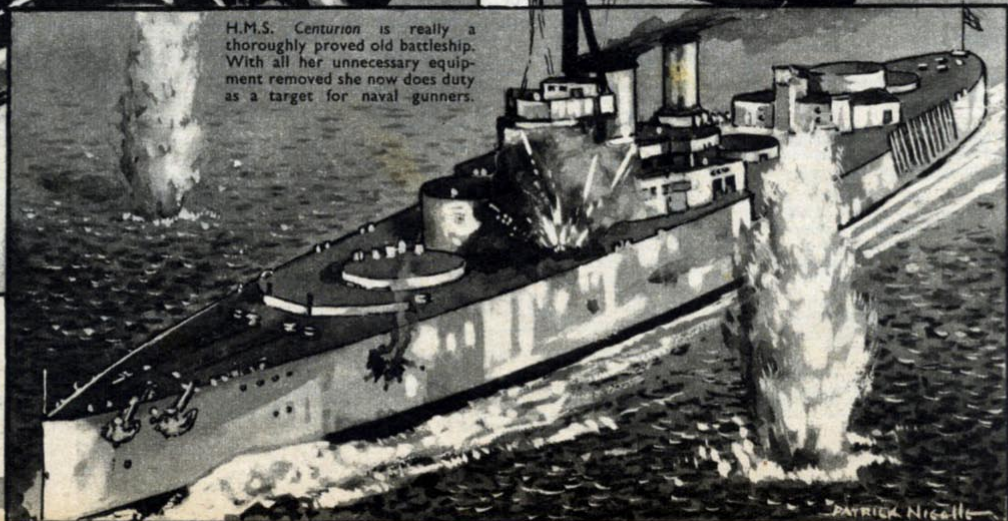
Towed out to sea, this screen is cut loose and left to float as a target for naval gunners.



Fast motor-boats, manned by a crew of three men, covered with bomb-proof steel armoured, race through the water, while overhead drone fast bombers, deadly accurate in their aim.



H.M.S. Centurion is really a thoroughly proved old battleship. With all her unnecessary equipment removed she now does duty as a target for naval gunners.



(Above) Mainly fast single-seater fighters use the ground target. Swooping to the ground, the pilot only gets a chance for a quick burst of fire.

(Above) Probably the best known of the gunnery practices for the R.A.F. is that of the towed target. Fast planes pull wind socks through the air.

Modern Wonder

Vol. 3, No. 68, Week ending September 3, 1938

**TWO PENCE
EVERY WEDNESDAY**

EACH WIND
DYNAMO
GENERATES 10,000 K.W.
AT 10,000 VOLTS

WIND DYNAMOS TILTED
FORWARD IN
STORM POSITION

INNER RING OF
LAMINATED IRON
CARRYING
DYNAMO
WINDING

OUTER RING OF STEEL
BLADES CAUSING DYNAMO
TO REVOLVE

WIND DYNAMOS
200-250 FT. DIA.
REVOLVE AT 10 REVS.
PER MINUTE

WIND ALWAYS
BLOWING ABOUT
1,000 FT. FROM GROUND

PLATFORM CARRYING
TILTING MECHANISM
1,000 FT. FROM GROUND

STEERING VANE TO
SET WHEELS ALWAYS
FACING THE WIND

INTERNAL STRUTS
OF STEEL TUBE
ENABLING TOWER
TO WITH-STAND
TORSIONAL STRESSES

LIFTS FOR
PASSENGERS &
CABLE SHAFTS

TOWER BUILT
OF TUBULAR
STEEL TRIANGLES

TRANSFORMER &
RECTIFIER HOUSE

TOWER RESTS ON
WIDE CONCRETE BASE

ELECTRICITY FROM MIGHTY WIND TOWERS

New designs of Herr Herman Honnef, a Berlin engineer, will enable mankind to generate electric power on the grand scale.

Every country has free wind, but not all countries have coal, oil or water from which to make electricity.

The Honnef Wind Dynamo now makes it possible to harness the wind and turn its energy to good account in any part of the world.

The full fascinating story of this amazing new invention is told inside.

LOWER TOWER SUPPORTS
6 FT. DIAMETER WELDED
STEEL TUBES

HEIGHT OF TOWER 1,500 FT.

IN THIS
ISSUE

MYSTERY OF ACOUSTICS • WONDERS OF MODERN
LINER • THE KING'S AIR FORCE • NEW GIANT MICROSCOPE

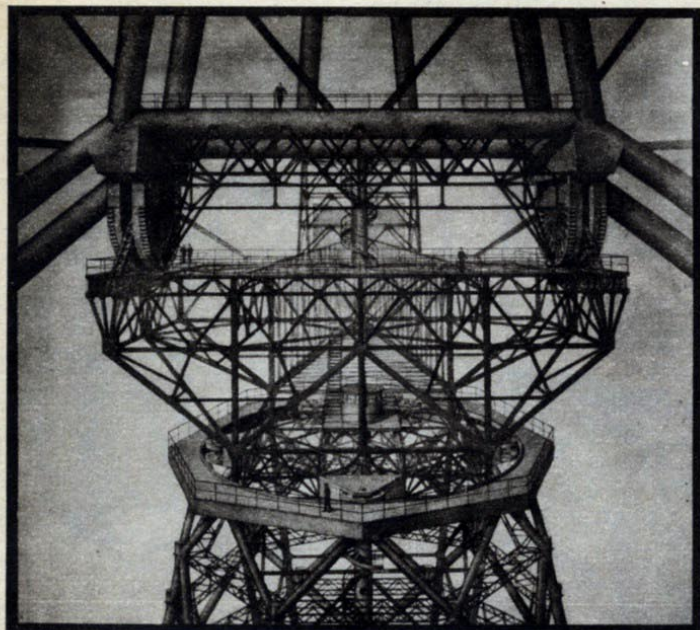


Illustration shows the platform at the top of the tower for carrying the tilting mechanism. The wind-blades revolve and tilt so that they always face the wind. The tremendous size of the tower can be realized by comparison with the man standing on the platform.

ELECTRICITY FROM THE WIND

★ MIGHTY CLOUD-HIGH DYNAMOS TO
HARNESS NATURAL FORCES

by W. E. WARRILOW, A.M.I.E.E.



THE discovery of electromagnetic induction over one hundred years ago by Michael Faraday gave the world the dynamo electric machine. That extremely simple generator of electrical energy, with its rotary motion and two plain bearings, placed at the disposal of mankind an instrument having more varied and far-reaching influences than any other human invention.

With the dynamo the future of civilization is secure. Through its agency, the world is being supplied with electric light, heat, power, transport, telephones, telegraphs, radio and television, to enumerate only a few of the wonderful gifts of electrical engineering to the world.

Even the gigantic achievements of steam pale into insignificance by comparison with what the dynamo electric machine has accomplished and, what is even more important, with what it has yet to accomplish, because there still remain important fields for the dynamo to conquer.

So far, through its agency, the latent powers of steam and falling water have been harnessed and today the world is filled with enormous generating plants which produce and distribute electricity on a vast scale.

But what of the wind whose fickle forces, sometimes gentle, sometimes of hurricane fury, yet remain untamed?

That is the next big step to be taken by electrical and mechanical engineers. The picture on the front cover shows how this will be done if the proposals of a German engineer, Herr Herman Honnef, are put into practical effect.

Wind dynamos of low horse power (5 h.p. is about the maximum) have been obtainable for many years, but nothing on the grand scale has yet been done to turn wind energy into electrical energy.

The Honnef Wind Tower will be built of steel tube welded together (*not riveted*) and will be raised higher than the Eiffel Tower in Paris, until it is one thousand five hundred feet above the ground. Herr Honnef discovered that at heights above one thousand feet *there is no calm*; the wind never falls in velocity below ten miles an hour.

That is why he builds so high; in order that his wind dynamos shall always keep revolving. His tower is to rest on a huge concrete base and will be without stay wires or cables.

From the pictures, you will see that he does not employ the gearing which is common, and indeed is essential, in small wind dynamos. The Honnef wind dynamo is of large diameter (two hundred to two hundred and fifty feet) and the electrical windings and magnetic iron which produce the current are built into the wind wheel itself. Electricity is generated at ten thousand volts, three phase, and is conducted by cables down the tower to

transformers which raise the voltage for transmission purposes.

Naturally you will ask what happens when gales, hurricanes and even tornadoes strike the Honnef wind tower. Most ingenious provision has been made for this. The pictures show you the wind-dynamos in a vertical plane for low and moderate winds and in a horizontal (or nearly so) plane for exceptional wind velocities.

The structure to which the dynamos are attached is mounted on a rolling platform known in engineering as a bascule, and by means of suitable machinery the entire framework is tilted forward so as to present a smaller surface of the vanes to the wind than when they are in a vertical position. It is the equivalent on a large scale of the "feathering" mechanism on all windmills.

And what will it cost to rear one of these giants to generate electricity in very large quantities?

The estimates of the inventor are that the capital outlay for a wind tower to generate 50,000 k.w. (equivalent to 80,000 h.p.) will be half that which was needed for London's largest steam turbo-generator station at Battersea; in this power house one unit of electricity per hour is produced for a farthing, but this same unit of electricity generated at the top of Honnef's wind tower would cost *one-tenth of a penny only*.

Many folk imagine that electricity generated from water power is the cheapest in the world, but in practice this is not the case, because the capital outlay for building a dam is so high compared with that required for a steam-generated station that the price for each unit generated must also be high, in order to obtain a commercial return on the money invested in the civil engineering works; that is why any large steam-driven engine can produce electricity more cheaply than can be done at Niagara Falls, for instance.

The possibilities of electricity production from wind are enormous. There is an abundance of wind in the world today. It is free to all countries. To quote that great book, the Bible, "it bloweth where it listeth," but it is now within the power of man to extract from it that colossal amount of horse power stored in its varying velocities.

Today, three-quarters of the electricity generated by mankind is derived from coal and oil. These valuable power agencies may become more and more difficult to obtain and with the tendency for them to disappear will come the greater need for an alternative.

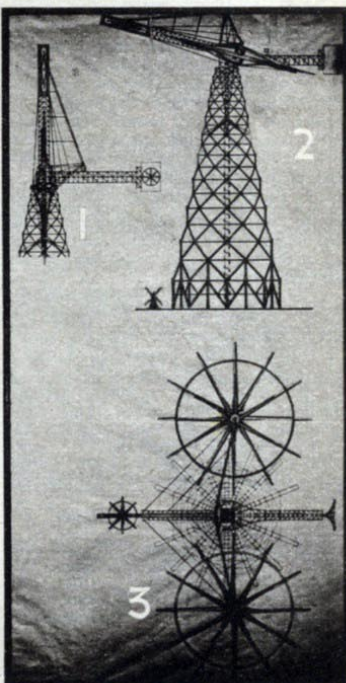
Mankind may rejoice in the fact that the existence of the dynamo and the constant presence of wind will preserve for humanity those stores of electricity which have now become its very life blood.

It is expected that Honnef wind dynamos will first be used for industrial purposes, producing very cheap electricity for making steel, aluminium, calcium carbide and metal alloys.

In his prophetic romance, "When the Sleeper Awakes," H. G. Wells pictured London as a city under glass. In an immense conservatory, its citizens lived

undisturbed by climatic changes; from many hundreds of acres of glass it collected all the water necessary to its daily requirements. In the matter of its electricity supply, Wells wrote perhaps more truly than he knew for he said that London's electricity would be generated by hundreds of little wind-dynamos mounted on the roof of this mammoth glass house.

All of this enables us to envisage the



Here is seen the arrangement of the wind-blades, (1) upright on a calm day to take advantage of every puff of wind, (2) pulled down on a stormy day to prevent excessive strain on the tower, (3) general arrangement of wind-blades and dynamos.

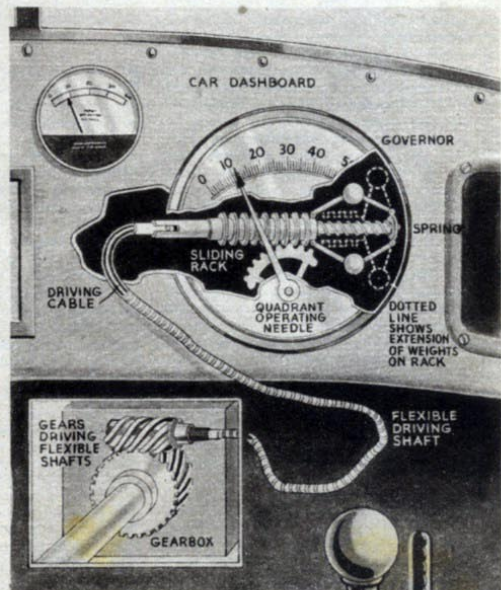
time when each house will have mounted on the roof a wind wheel directly driving its own miniature dynamo, supplying the electrical requirements of the household for every domestic purpose, but in conjunction with this diminutive power station there will be something which has yet to come in electrical engineering, viz., a reliable and efficient reservoir in which the electricity generated by the wind-dynamo during its "idle" hours will be stored for subsequent use.

Such a development would make each household independent of central sources of electricity supply.

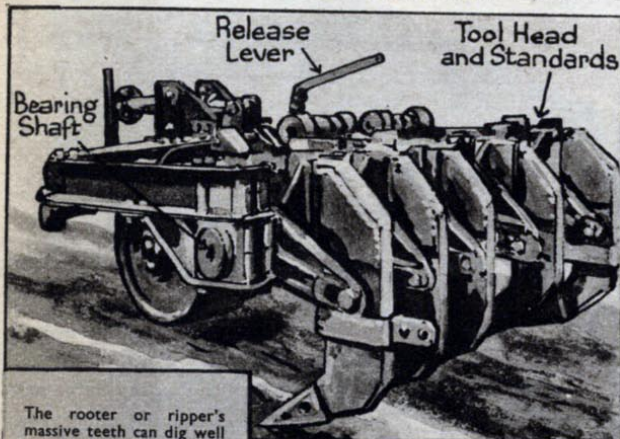
The Speedometer of a CAR

THIS instrument which is used in cars is worked by centrifugal force.

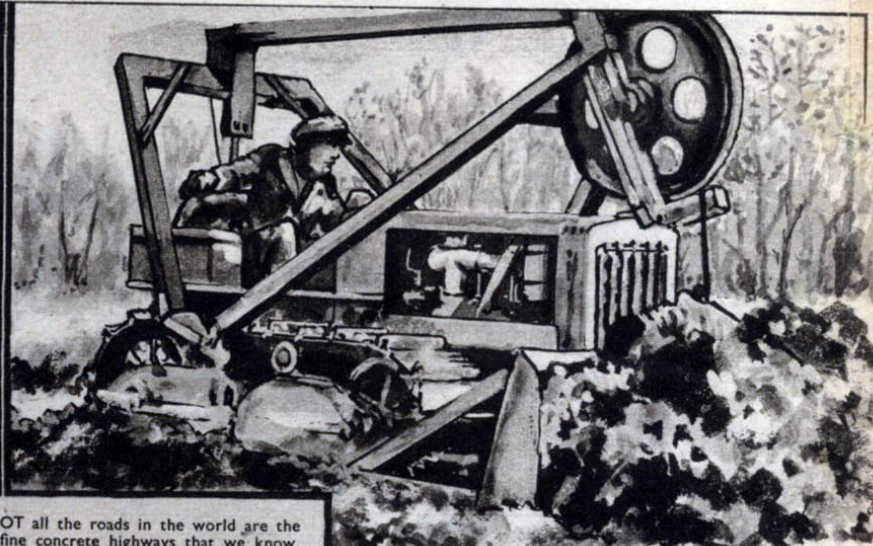
Two weights are attached by links to a sliding rack. A spring tends to push the rack backwards and the weights inwards, when the shaft and weights are rotated by a flexible drive from the gearbox. The weights fly outwards as the speed increases and by means of a toothed quadrant a needle is made to register the miles per hour on a dial. The speed of the car at any moment is thus indicated.



CUTTING ROADS THROUGH THE JUNGLE



The rooter or ripper's massive teeth can dig well down and tear up roots of trees, and rocks too. A five standard machine such as this will need a .75 h.p. tractor, and it weighs about 3½ tons.



The bulldozer clearing away the loose earth and trash. Its curved plough-like blade gets under the earth, and the action is more in the nature of rolling. The pulley and winch above is for adjusting the depth of the plough blade.



A ripper in action. Two of the standards have been removed for easier haulage through rocky ground. Observe the size of the rocks dug out. The release lever and rope can be seen, this is for releasing the tynes when too heavy an obstruction is encountered.

NOT all the roads in the world are the fine concrete highways that we know.

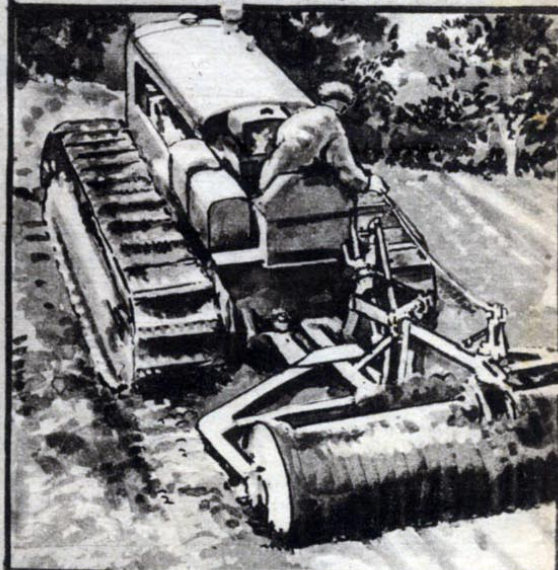
The vast majority of them are earth roads, with little or no surfacing at all, not designed to carry any heavy traffic obviously, but essential as trails for the carriage of merchandise. Cutting such roads as these through the jungle or bush is a big job, which can only be done by brute force, as a rule. The caterpillar type of tractor has made it easier than it was in older days when the levelling machines had to be hauled along by horses or oxen. The crawling tracks can cross terrain of the most impossible-looking sort, and moreover can haul heavy drags behind them with ease.

After the woodmen have passed over the surveyed route, cutting down the trees and blasting out the stumps, the rooter or ripper is towed over it several times in each direction. This machine is shown at the top left, with five teeth or "tynes," shod with the toughest manganese steel. Its tynes dig in about fourteen inches, bringing out all rocks and roots, loosening the soil as well.

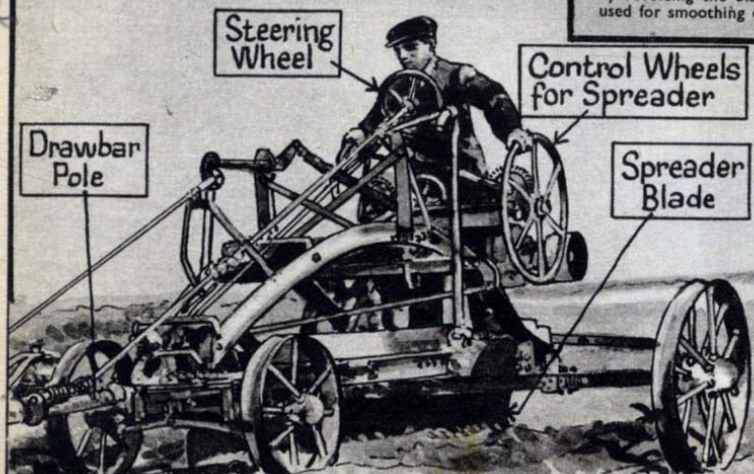
Following the ripper comes the bulldozer, also powered by a caterpillar, pushing this time. This machine digs out all the rocks and loose soil, pushing it over to one side. For working on the side of a hill, its blade can be tilted at an angle, to cut in more on one side than the other.

Once a rough track is cleared, the scraper and grader can get to work. These are both tractor drawn. The first is dragged over the surface, levelling it out, distributing the soil, and throwing some of it to one side ready for the grader. By dragging it over the track several times gradients can be levelled out.

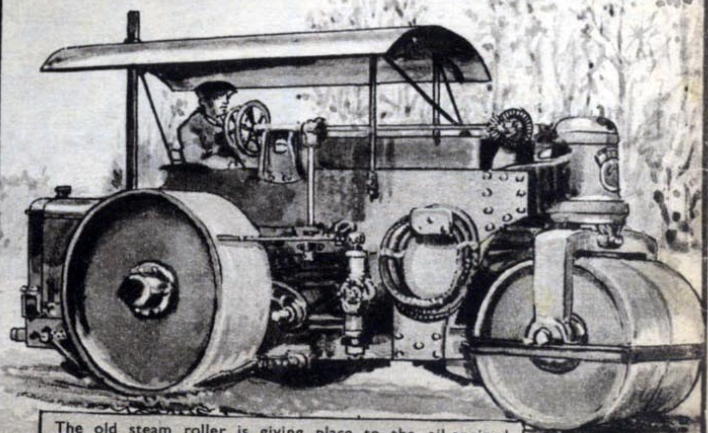
The grader's job is to finish the surface, its curved blade can be set at a variety of angles, lifting some of the earth to the centre of the road to form a camber, and digging at the outside to form a ditch. Then, by reversing the blade, its rounded back is used for smoothing over the surface.



The scraper consists of a cylindrical box with a cutter-blade, which is dragged over the surface. By hauling it over hills, the gradient can be much reduced; this process is here seen in action.



The grader is an open framework on wheels, with a curved blade projecting below. The operator has two wheels for adjusting the setting of the blade, and he can steer the machine independent of the hauling tractor. Reversing the blade makes it possible to smooth out the surface for light traffic.

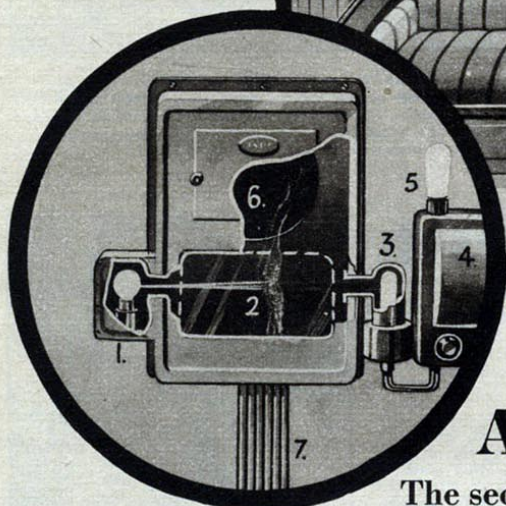
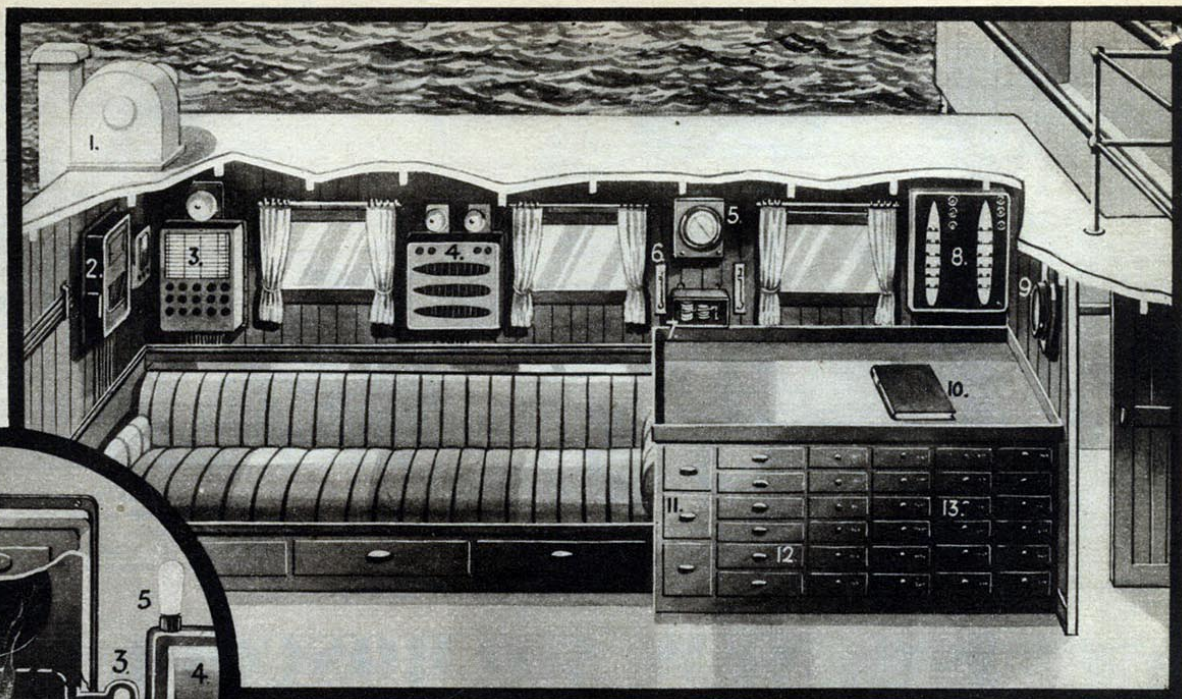


The old steam roller is giving place to the oil-engined machine, which is much more suitable for undeveloped countries. The type shown has a 35 h.p. engine, power steering, automatic reverse and water ballast wheels. Its weight is about seventeen tons.

-R.B.WAY-

INSIDE THE CHART HOUSE

1. Smoke detector exhaust fan
2. Smoke detector
3. Fire alarm indicator
4. Sprinkler alarm
5. Aneroid barometer
6. Thermometer
7. Barograph
8. Watertight door indicator
9. Mercury barometer
10. Flag book
11. Signal lamp drawers
12. National ensign lockers
13. Signal flag lockers



Arrangement of photo-electric equipment for smoke detection

1. Light source
2. Smoke from hold breaking light ray
3. Photo-electric cell sending impulse to amplifier
4. Amplifier
5. Warning light
6. Outlet to suction fan
7. Inlet from holds, etc.

It is almost a practical impossibility, in the modern liner, for a fire to occur of such magnitude that there is not time to extinguish it. In fact with the contrivances at present fitted the cost of insuring the vessel is considerably reduced for that reason.

Naturally the bridge will need to know all about any outbreak which may occur and the officer of the watch is informed in the following manner.

Fire Alarm Indicator

At numerous points in the ship will be seen small boxes with a bell-push inside a glass front. These are the fire alarms. The glass must be broken and the bell-push pressed in order to sound an alarm bell in the chart room, and there is an indicator light for each alarm position. Portable telephones are provided, one for use plugged into the indicated position on the board and the other to be plugged into the box from which the alarm came.

Sprinkler Alarms

Many ships are fitted with an automatic means of extinguishing fires in all parts of the ship, such as cabins, alleyways, public rooms, etc. A series of pipes are led to these places and the ends of the pipes are sealed with a bulb of material similar to glass which will burst at a high temperature, about one hundred and seventy-five degrees Fahrenheit.

Water is laid on in these pipes at high pressure; somewhere about one hundred pounds to the square inch. It follows that if a pipe becomes unsealed due to fire bursting the bulb, there will result a powerful stream of water. This is fresh

water to begin with, in order that a minimum of damage will occur in a small outbreak or as the result of an accident in the system such as a burst pipe.

All these pipes are divided into groups, possibly about twenty all told and a local valve is fitted to each in order that the water may be turned off. The sealed ends of the pipes are called sprinklers and should one of them go off, an alarm bell will ring on our indicator board and an indicator light show at the number of the group. Reference to a plan or picture of the ship just alongside will show the position of the group.

Smoke Indicator and Alarm

All parts of the ship not protected by sprinklers and thus not in use while the ship is at sea are watched by another series of pipes. We shall find them in all the cargo holds, mail rooms, etc. These have open ends, both in the compartment watched and at the indicator.

Exhaust fans are continually drawing air through them upwards to the chart room and each line opens in a glass-fronted locker with its source clearly shown on a name plate, for instance No. 3 mail room. Should there be a fire down below, fire never coming without smoke, it follows that smoke will be drawn through the pipe serving the space affected and thus to the smoke indicator.

In addition each line is tested in turn by passing the exhaust air through a photo-electric cell. The presence of smoke will break the ray and cause an alarm bell to ring. The officer of the watch therefore can see, smell and hear smoke in the event

of a fire in unprotected spaces and take action as required to bring the extinguishers into effect.

There are various methods of putting the fire out and localizing it such as steam, water and patent liquid with mats and other means for stopping draughts.

From the above it can be seen that nothing is left to chance these days and it is highly unlikely that there will be a recurrence of the terrible fires which have occurred at sea in the past.

Watertight Doors

Ships are divided into a number of watertight compartments so that in the event of a collision admitting water to any particular part, the whole ship will not be flooded. These compartments are fitted with doors to allow access and the doors can be closed electrically from the chart room. Indicators at the control show when the doors are open or closed. They are always closed in foggy or thick weather and when any danger is imminent such as collision or fire.

In addition to all the devices which indicate when action is taken or action is necessary by the officer of the watch there is the department which can prepare us for some of these steps and this is the meteorological or weather department. Our ship regularly transmits and receives weather messages and thus a forecast as given by the B.B.C. can be prepared.

There are allotted spaces for the necessary instruments, books, etc. We shall see barographs and aneroid and mercury barometers for measuring the pressure of the atmosphere. Thermometers,

wet, dry and sea for measuring the temperature and many others which would need too long a description to attempt here.

Lastly, but not least, we come to flags. These do not perform quite as many duties since the introduction of wireless telegraphy but they are still a necessary part of a modern ship's equipment. We carry two complete sets of International Code Flags in specially constructed lockers in the chart room.

These lockers have a separate compartment for each flag to allow them to be found easily and there is a window handy in order to pass them outside to be made fast to the halliards. On opening the lockers we see two alphabets from A to Z and numerals from 0 to 9, with other places for odd flags like Pilot Jacks, Quarantine, etc.

There is a locker for all the national ensigns. These are hoisted as a courtesy gesture when visiting foreign ports.

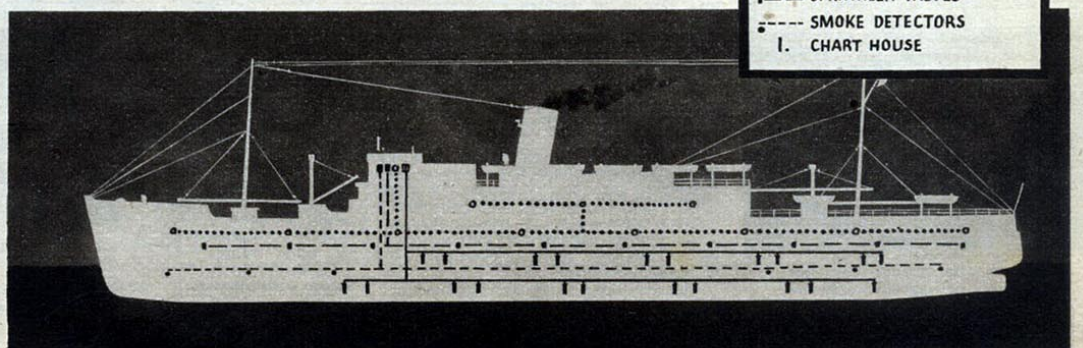
Everything must be ready to hand since time does not wait when a ship is doing possibly twenty miles an hour and wants to communicate with another approaching at the same speed.

Then we have a box of various coloured electric bulbs for night signal purposes such as two red lights hoisted vertically about six feet apart to mean that the ship is out of control with engine or steering gear trouble.

But, you will say, surely in the modern liner that would not be necessary and I can only reply that the unexpected does happen and that is why every precaution possible is fitted and the further advance of science will see more additions with, we hope, a device to combat the mariners hated enemy—fog. There is a means of seeing through fog but it is not yet sufficiently advanced to allow us to proceed while using it.

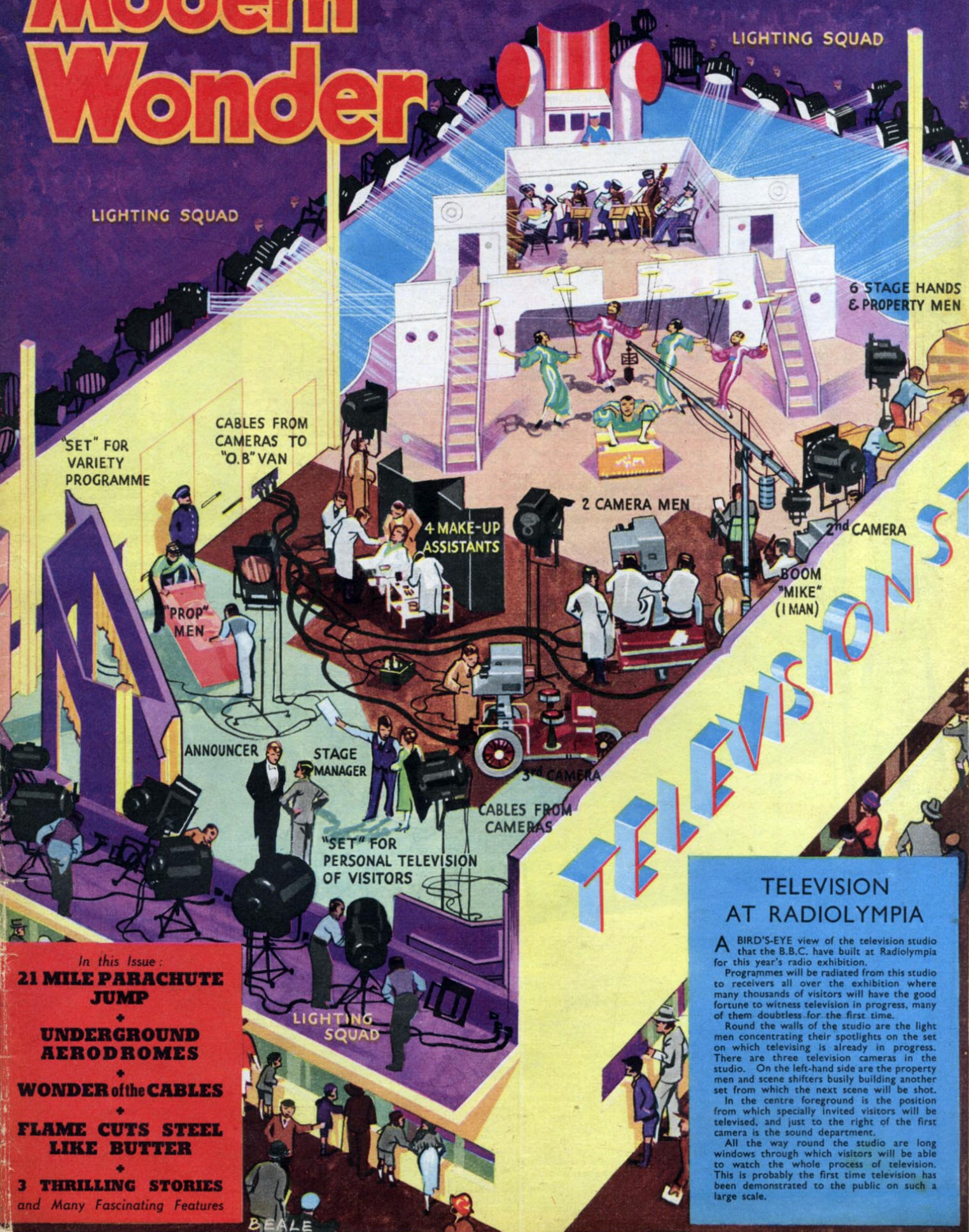
KEY TO DIAGRAM OF CONTROLS

- FIRE ALARM INDICATORS
- WATERTIGHT DOOR CONTROLS
- SPRINKLER VALVES
- SMOKE DETECTORS
- I. CHART HOUSE



Modern Wonder

TWOPENCE
EVERY WEDNESDAY



2 CAMERA MEN

2nd CAMERA

BOOM
"MIKE"
(1 MAN)

4 MAKE-UP
ASSISTANTS

PROP
MEN

ANNOUNCER

STAGE
MANAGER

CABLES FROM
CAMERAS

"SET" FOR
PERSONAL TELEVISION
OF VISITORS

LIGHTING
SQUAD

TELEVISION'S

TELEVISION AT RADIOLYMPIA

A BIRD'S-EYE view of the television studio that the B.B.C. have built at Radiolympia for this year's radio exhibition.

Programmes will be radiated from this studio to receivers all over the exhibition where many thousands of visitors will have the good fortune to witness television in progress, many of them doubtless for the first time.

Round the walls of the studio are the light men concentrating their spotlights on the set on which televising is already in progress. There are three television cameras in the studio. On the left-hand side are the property men and scene shifters busily building another set from which the next scene will be shot.

In the centre foreground is the position from which specially invited visitors will be televised, and just to the right of the first camera is the sound department.

All the way round the studio are long windows through which visitors will be able to watch the whole process of television. This is probably the first time television has been demonstrated to the public on such a large scale.

In this Issue:

**21 MILE PARACHUTE
JUMP**

**UNDERGROUND
AERODROMES**

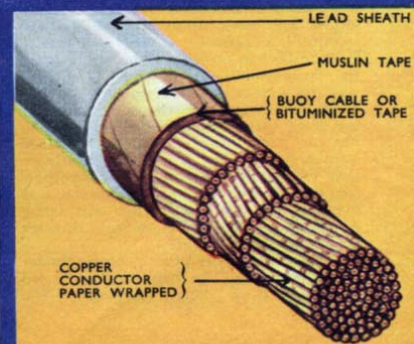
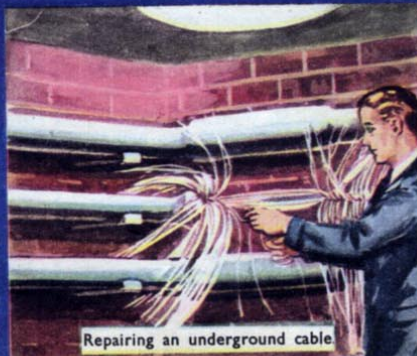
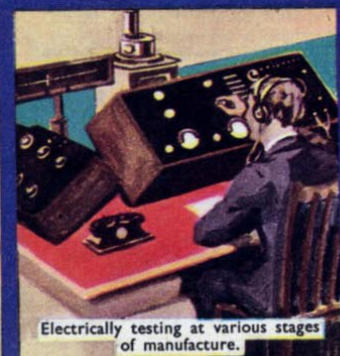
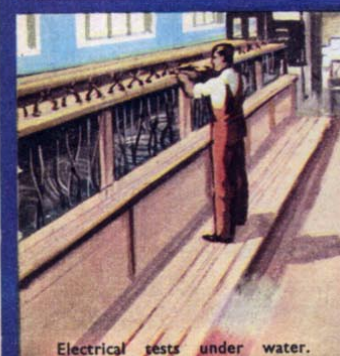
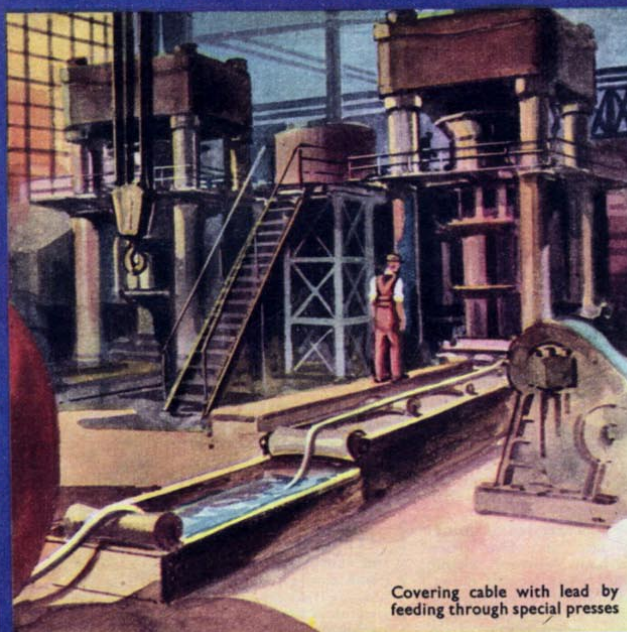
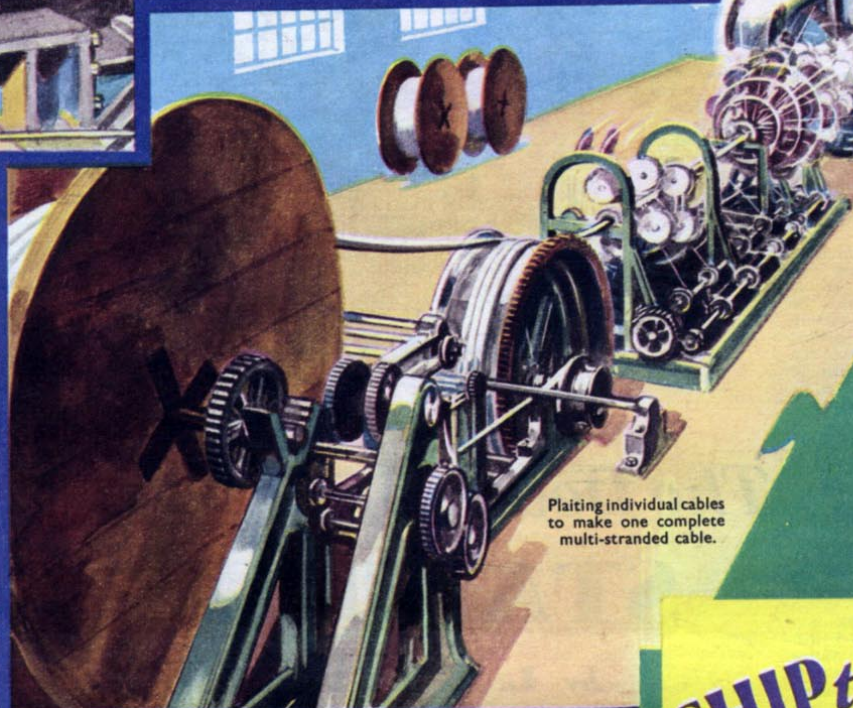
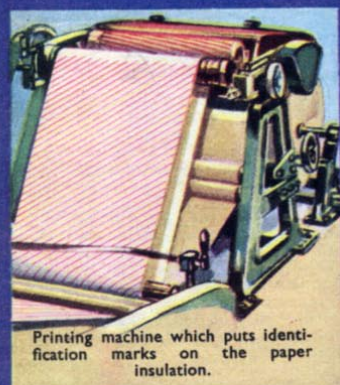
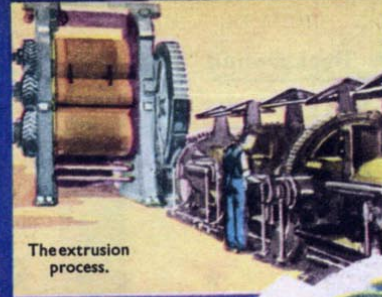
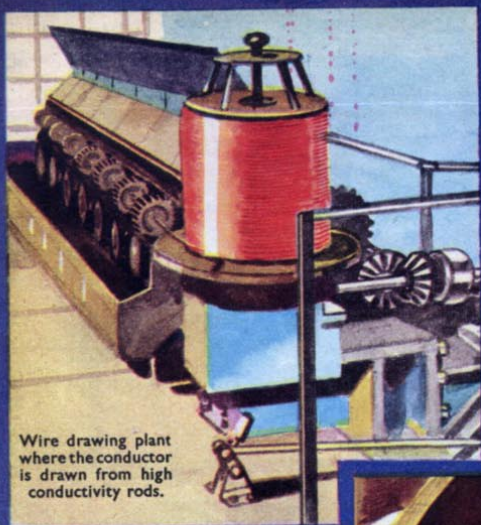
WONDER of the CABLES

**FLAME CUTS STEEL
LIKE BUTTER**

3 THRILLING STORIES

and Many Fascinating Features

BEALE



SHIP that LINKS

MAKING, LAYING & REPAIRING A TELEGRAPH

THE first submarine cable was laid between Great Britain and the Continent in 1850, followed by the first transatlantic cable in 1858, after nearly a year of preparation and disappointment.

The manufacture of modern deep sea cables has to be very scientifically carried out and the illustrations round the left-hand sides of this page show the various processes in the manufacture of cables.

WIRE DRAWING PLANT. The conductor of the cable is copper wire drawn from high conductivity rods in the wire drawing plant.

Following the pictures along the top of the left-hand corner, we see some of the processes carried out after the conductor has been made and when it is to be used for submarine cable. For work under water or where greatest insulation is necessary, gutta percha is used, but for lighter types of cable paper is adequate. The processes for paper insulation are shown in the pictures down the left of the page.

MIXING PLANT. The raw gutta percha is sorted into various grades which are carefully analysed and tested. Experience has shown what proportion of the various grades should be used to obtain insulation of the required standard, and mixing of these grades is carried out in the mixing plant.

EXTRUSION PROCESSING—The extrusion operations have to be controlled to ensure that the product is perfect from end to end for microscopic examination and electrical analysis and electrical tests at various stages during the process.

PRINTING MACHINES—The machines for insulation are of the type used for printing and on this machine the insulation is applied so that the various wires are insulated separately.

WRAPPING MACHINES—The wires prepared and printed are then wrapped in a machine together with the paper is wrapped evenly and tightly.

IMPREGNATION. Impregnating the cable is one of the parts of manufacture. The moisture must be removed and to ensure that the drying the impregnation. The covering of the cable is out by feeding into the most modern design.

ELECTRICAL TESTS. The core tank-room

KEY TO THE CABLE LAYING SHIP

- | | |
|--------------------------------------|------------------------------|
| 1. Sheaves | 15. Petty officers' quarters |
| 2. Drum-room | 16. Sleeping quarters |
| 3. Cable machine | 17. Fresh-water tanks |
| 4. Hospital | 18. Engines |
| 5. Engineers' and officers' quarters | 19. Boilers |
| 6. Wireless-room | 20. Oil fuel |
| 7. Dining-room | 21. Cable tank |
| 8. Bridge | 22. Cable tank |
| 9. Smoke-room | 23. Cable tank (in section) |
| 10. Testing-room | 24. Cable tank |
| 11. Greasers | 25. Oil fuel |
| 12. Meat stores | 26. Hold for stowing buoys |
| 13. Vegetable stores | 27. Chain lockers |
| 14. Engineers' quarters | 28. Fresh-water tanks |

Across the WORLD

ING AND GRAPH CABLE

ON PROCESS. These delicate have to be very carefully consure that the resulting core is end to end. Samples are taken topic examination, and general electrical tests are made at es during the process.

ING MACHINE. The paper used on is of the highest quality, machine the stripe is printed various wires can be identified. **ING MACHINE.** The specially d printed paper passes into this ether with the conductor, and wrapped round the conductor ightly.

ATION. Drying and impregable is one of the most critical ufacture. In the drying process ust be completely extracted, re that none can return after mpregnation is done in a vacuum. g of the cable with lead is carried ding into lead presses of the n design.

AL TESTS UNDER WATER. ank-room allows any quantity

up to 1,000 nautical miles of cable to be tested under water, at various temperatures.

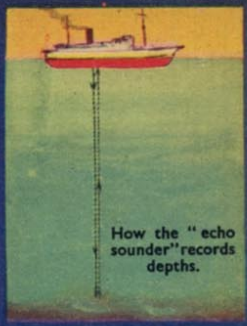
TESTING APPARATUS. In the testing department all kinds of tests are made on material during manufacture, and on the finished cable when ready. Insulating material is examined and problems such as corrosion and deterioration are studied.

Before cable-laying can start several months of careful planning is necessary. A survey is made and when this is completed a cable ship of the kind illustrated sets out with the cable coiled in cable tanks. As it steams over the charted course it drops buoys at intervals of five or six miles, and takes depth readings at regular intervals. The cable is paid out over the stern for long distances, but for short distances over the bows of the ship.

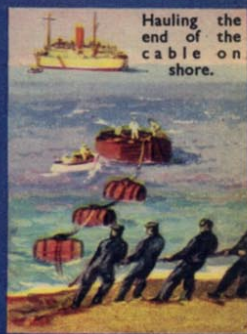
Repairing cable which has become damaged on the sea bed is illustrated in the sketches on the right. In the cable hut on the shore there are delicate instruments which indicate where a fault has developed. The cable ship then steams to the position and it is marked with a buoy. A grapnel attached to a long hawser is lowered and is trailed on the bed of the ocean until the cable is caught. It is then hauled up, sawn through and tested in each direction to ascertain in which section the fault lies.



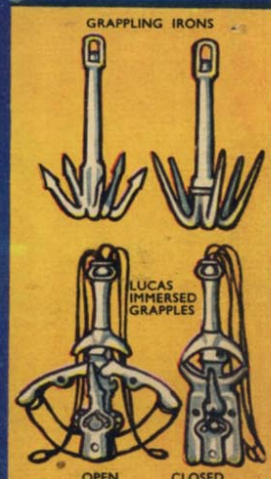
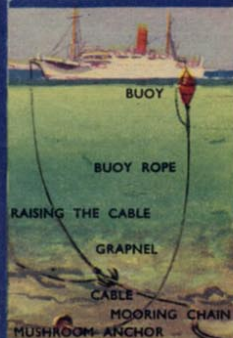
Lowering a buoy from the cable ship.

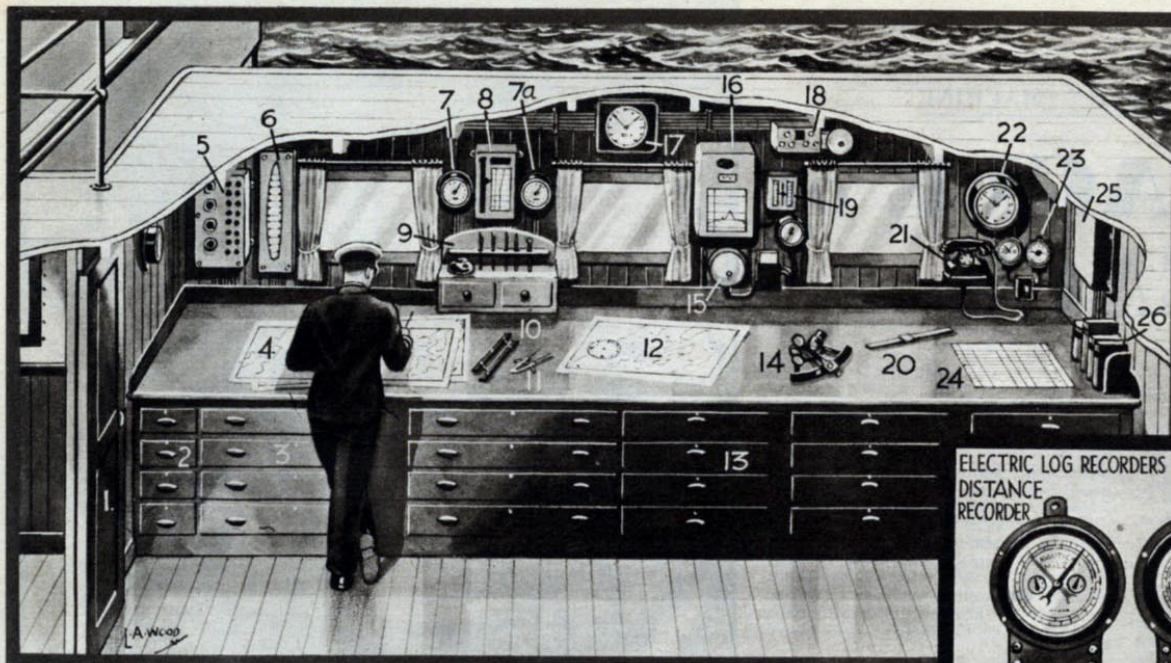


Feeding cable from the stern of the ship.



Hauling the end of the cable on shore.





INTERIOR OF CHART HOUSE

1. Sliding door from bridge
2. Instrument drawers
3. Large scale chart
4. Large scale chart
5. Master switches for hold and cargo lights
6. Scuttle indicator
- 7 - 7a. Port and starboard engine rev. counter
8. Course recorder
9. Pens and instruments
10. Parallel ruler
11. Dividers
12. Small scale chart
13. Small scale chart drawers
14. Sextant
15. Alarm bell
16. Echo sounding recorder
17. Master electric clock
18. Navigation light indicator and alarm
19. Draft indicator
20. Slide rule
21. Telephone to all parts of ship
22. Chronometer
23. Electric log recorders
24. Calculation tables
25. Switches and fuses
26. Code books

SCIENCE in a MODERN LINER

STANDING in the middle of the room on the bridge of a ship, which is the focal point or control point of nearly everything that happens in a ship, one always looks in vain for a vacant space on the walls. After considering the following notes on the gear contained in that room, one is apt to wonder where it all goes.

Apart from large tables along one side for spreading out the charts, there are drawers and lockers underneath to stow them in, bookcases and batches of electric switches, fuses, resistances and induction chokes decorate the walls.

In addition there are numerous printed notices appertaining to the safe navigation of the ship. Then the following have to find a home, in the remaining space.

The Echo Sounding Device

The echo sounding device, with its attendant boxes and lockers. Of this I will just say that it is the most recent means of obtaining the depth of the sea, in a practically instantaneous manner, and it even draws a map of the sea-bottom.

Revolution Counter

A box, wired electrically from the

engine room, which will count the revolutions of the propellers. From knowing the number of times that the propellers go round each minute, the speed of the ship can be deduced.

An electric contact is made each time the propeller shaft turns and this moves the counter one place. A red or green light flashes according to whether contact is made by the port or starboard engine.

Electric Logs

These are not electrified lumps of wood as may be imagined, but are another means of measuring the speed of the ship. Actually, the "log" part of it was originally true. In the old sailing ship days a piece of wood was thrown over the side in front of the ship. The time it took to travel a known distance was noted.

By calculation of the time it took to go a known number of yards, a fairly accurate speed in distance per hour was obtained.

The old-fashioned line and rotator log is still used over the stern of the ship, but it now has an electric repeat. This rotator revolves by means of its fins as the ship goes along, and transmits the revolutions to a clock which turns them into miles.

The reading is then electrically repeated to the dial in the Chart Room. A second type is fitted in the bottom of the ship through a protruding tube and is actuated by direct water pressure either on a little propeller or on a bellows.

This pressure is again measured, turned into speed and distance, and we have thus a real speedometer on which to read the speed of the ship at any moment.

Draft Indicator

The ship is marked "forward" and "aft" on the

stem and stern with figures indicating the number of feet from the bottom of the ship. Thus "25" would mean that twenty-five feet of ship is submerged at that point.

It would be very inconvenient to send a man over the side each time the reading was required, so an instrument has been made which will do this. It consists of two mercury tubes acting as gauges or measures, worked by pump pressure. These give, on a scale, the same reading as is on both ends of the ship.

These are in feet and inches, and are called the "draft" of the ship. This is very useful in shallow water, as the "draft" can immediately be seen.

If the ship is approaching a channel in which the water at the time is only twenty-four feet deep, while the draft is twenty-five feet, it is obvious that the ship must wait for the tide to rise before venturing up that channel.

Navigation Light Indicator and Alarm

Most readers have seen a ship at sea after dark, and observed her navigation lights. These are usually two white lights on the masts, with red and green lights on the port and starboard sides (left and right looking ahead), with another white light showing behind or astern.

The electrical circuit to these lights is led through small indicator lamps in the Chart Room, and if one of the navigation lights goes out accidentally the circuit is broken. This rings an alarm bell and the small indicator light is extinguished.

Before this system was introduced the look-out man in the "eyes of the ship" had to report each half-hour by hailing the bridge with "All's well and the lights

are burning brightly," but now that is unnecessary.

Alarm Gongs, Buzzers and Hooters for Emergency

Alarm bells in every part of the ship can be used for warning an immediate muster to the boats.

Master Control Switches

To prevent any danger from fire, the bright lights used in the holds for loading have red pilot lamps fitted to the operating switches on the bridge. The officer of the watch can see that unwanted lights are switched off.

Electric Master Clock

Modern ships are fitted throughout with electric clocks. So that these always conform with the time in various parts of the world, a master clock is fitted in the Chart Room and adjustment of this alters the others accordingly.

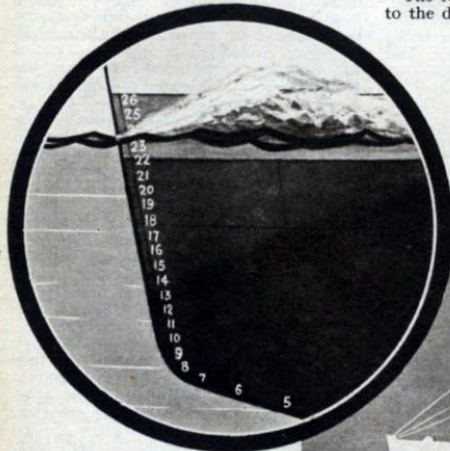
Chronometers (in the Chart Room)

These are very accurate and expensive time-pieces which are used for navigation. The error has to be known to the nearest second, because a mistake of one second can mean an error of a quarter of a mile in the calculated position of the ship.

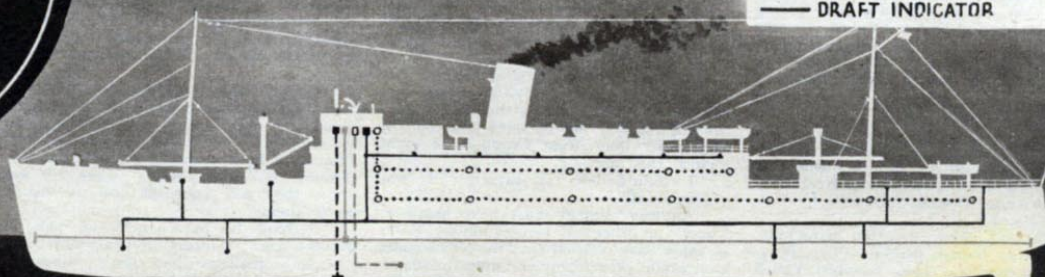
KEY TO DIAGRAM OF CONTROLS

I. CHART HOUSE

- ECHO SOUNDING GEAR
- HOLD & CARGO LIGHTS
- o---o MASTER CLOCK CIRCUIT
- ELECTRIC LOG GEAR
- DRAFT INDICATOR



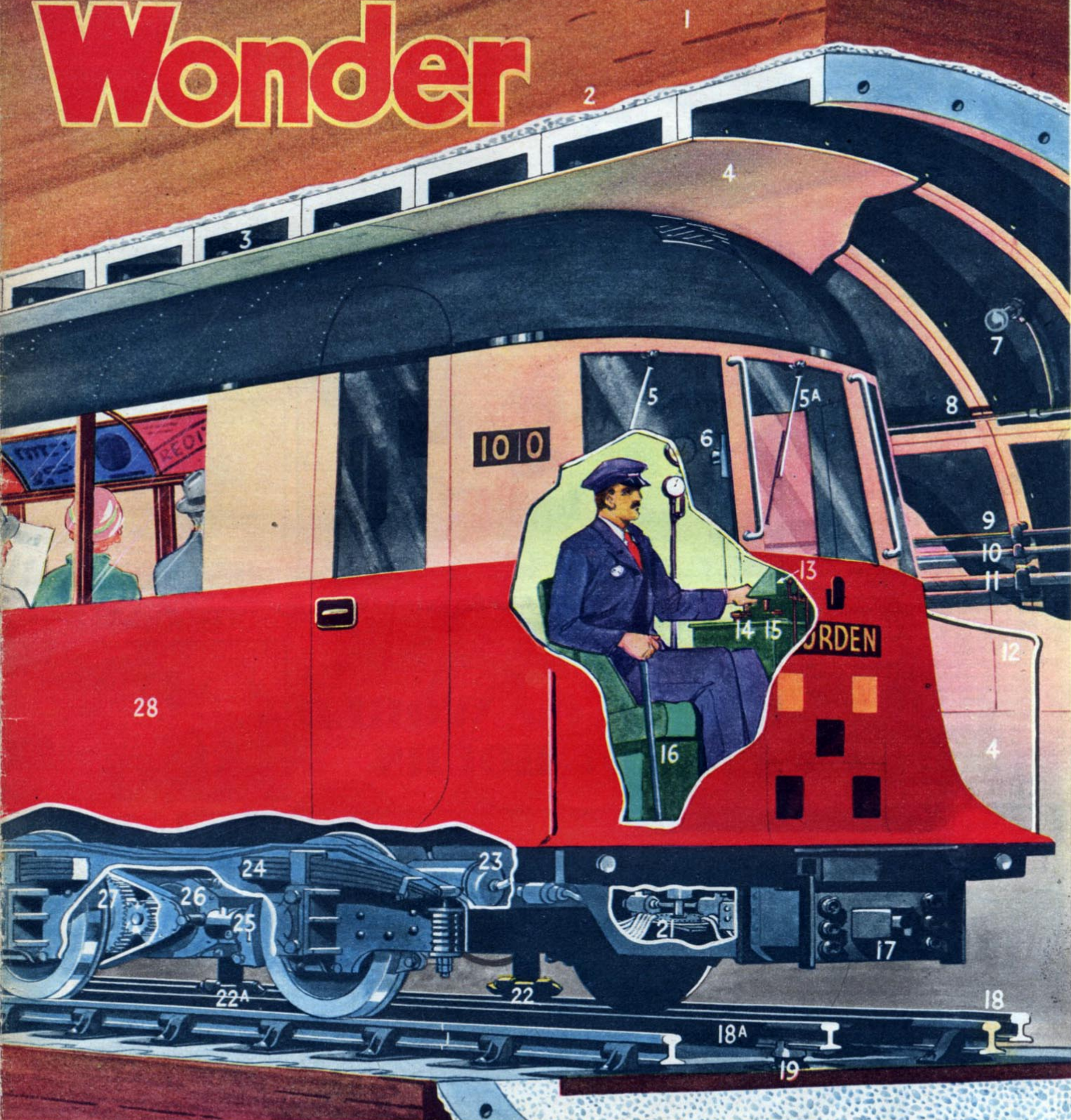
Draft figures indicating depth to which hull of ship is submerged or how much she "draws."



Modern Wonder

TWO PENCE
EVERY WEDNESDAY

Vol. 3, No. 66. Week ending August 20, 1938



LONDON'S STREAMLINED TUBE TRAIN

There are four of these trains made up of six cars each and developing 1,656 h.p., running on 600 volts D.C. They have greater acceleration and braking power and are now in service on the Piccadilly Line.

A great feature is that all the control gear and motors, etc., are beneath the floor, thus giving greater seating capacity. The rail clearance to do this is only sixteen inches.

1. Section through London clay
2. Concrete lining 3. Section of steel tunnel
4. Asbestos-lined tunnel to eliminate noise
- 5, 5A. Electric windscreen wipers
6. Driver's loud-speaker
7. Tunnel lighting unit for workmen
8. Tunnel lighting cable 9. Telephone cables
10. Automatic signal cables 11. Power cable
12. Hand-rail 13. Brake gauges
14. Electro-pneumatic brake handle
15. Automatic air brake handle
16. Joy-stick control 17. Automatic coupling
- 18, 18A. Live rails 19. Insulator
20. Concrete foundation for track
21. Face-plate controller
- 22, 22A. Contact shoes 23. Air reservoir
24. Power bogie 25. Brake cylinder and shoe
26. 138 h.p. traction motor 27. Driving gears
28. Extra space for passengers instead of the old motor-room

LASKWELL WOOD

Modern Wonder

Vol. 3, No. 53, Week ending July 30, 1938

TWOPENCE
EVERY WEDNESDAY



LASHWELL
WOOD

NEW WONDER SUBMARINE

THE "Porpoise" class of submarines, are the latest and only mine-laying submarines in the British Navy. Picture above shows one submerged and just firing a torpedo from her bows. They are 271 feet long and weigh 1,520 tons on surface and 2,140 tons submerged, thus

620 tons of water are used for submerging. They carry a crew of 55; one 4-inch gun, two machine-guns and six 21-inch torpedo tubes. Their 3,300 h.p. Diesel engines give a surface speed of 17 knots and their 1,630 h.p. electric motors a submerged speed of 8½ knots.

- | | | | | |
|---------------------------|--------------------------------------|---------------------------------------|-------------------|--|
| 1. Steering periscope | 7. Conning tower | 13. Captain | 14. First officer | 22-22A. Battery tanks |
| 2. Captain's periscope | 8. Conning tower hatch | 15. Third officer | 16. Hatch | 23. Periscope well |
| 3. Jumping wire | 9. Signal locker | 17. Helmsman at steering wheel | | 24. Internal ballast tank |
| 4. Surface steering wheel | 10. Mines carried in this after deck | 18-19. Hydroplane control wheels | | 25. Forward torpedo tubes |
| 5. Wireless aerial | 11. External ballast tanks | 20-20A. Compressed air bottles | | 26. Torpedo, fired with practice head (non-explosive). |
| 6. 4-inch gun | 12. Pressure hull | 21. Compressed air high pressure pipe | | |

GRAND NAVY WEEK NUMBER

SPECIAL FEATURES DEALING WITH THE
FLEET—UNDER THE WATER... ON THE
WATER... AND OVER THE WATER.

ALSO MANY OTHER FASCINATING
ARTICLES AND STORIES

and was closely examining the iron hand-rail.

Calling to the superintendent he pointed to two long, narrow scratches that showed up whitely on the painted surface.

"Those have been freshly made," he exclaimed. "Probably by some object such as a metal guard that is often worn on the heel of a walking shoe."

"But surely," protested Leslie, "no one would try to stand on the rail!"

"Unless he happened to be a half-wit or an acrobat!" Sir Walter amended dryly. "But if an insensible man was being carried down on someone's shoulders, it is quite conceivable that his feet might scrape against the rail."

Followed by the others, he made his way slowly down the iron staircase, pausing every few yards to examine the paintwork, but it was not until he reached the courtyard that he found anything that appeared to be significant. A few yards, from the foot of the stairway was a small flower bed, and over this Sir Walter was bending when the others joined him.

"There are traces of what certainly looks like blood on the earth here," he told them. "If you will send one of your men for a small wooden box we will send the soil along for analysis."

As the superintendent hurried off to call one of his men, Chain pointed to where a long-handled broom stood in one corner of the yard leaning against the wall, telling Leslie to bring it to him. Wonderingly, the youngest obeyed, and Sir Walter set about banging the surface of the ground all round the blood-stained patch.

Looking up from his task and catching the expression of amazement on his young assistant's face, he smiled. "No, young fellow," he said. "I haven't gone off my head! But the ground is still quite damp after the early morning rain—which means there are worms in plenty near the surface. And worms have a habit of absorbing any blood that has soaked in the ground."

"Then why not put down tanning-water or a tobacco concoction and get rid of them?"

"The Public Analyst would skin you alive if you sent him a sample of earth you had spoiled like that!" retorted Sir Walter. "Especially as it is quite an easy matter to get rid of earth-worms by beating the ground. They cannot keep below the surface when the earth is being jarred in this manner and so they make their way to the top where they can be removed easily."

As he spoke, Scarlyn reappeared accompanied by a self-conscious man in uniform carrying a small wooden box. Giving the constable instructions to remove the infected soil with a knife, place it in the box and take it at once to the Yard for analysis, Sir Walter turned to the detective.

"Well, it looks as though poor Redpath has been abducted," he said. "And the next question is, where have they taken him?"

"Come up to the flat again," Scarlyn invited. "I want to show you something."

Obediently the others followed him up to the sitting-room where the detective crossed to the window and beckoned to Sir Walter to join him.

"Look down there," he said. "See that fellow leaning up against the rail leading to the steps down to the river? Well, he has been hanging about here for some hours according to one of my men. Doubtless he is waiting to see what develops here in the flat."

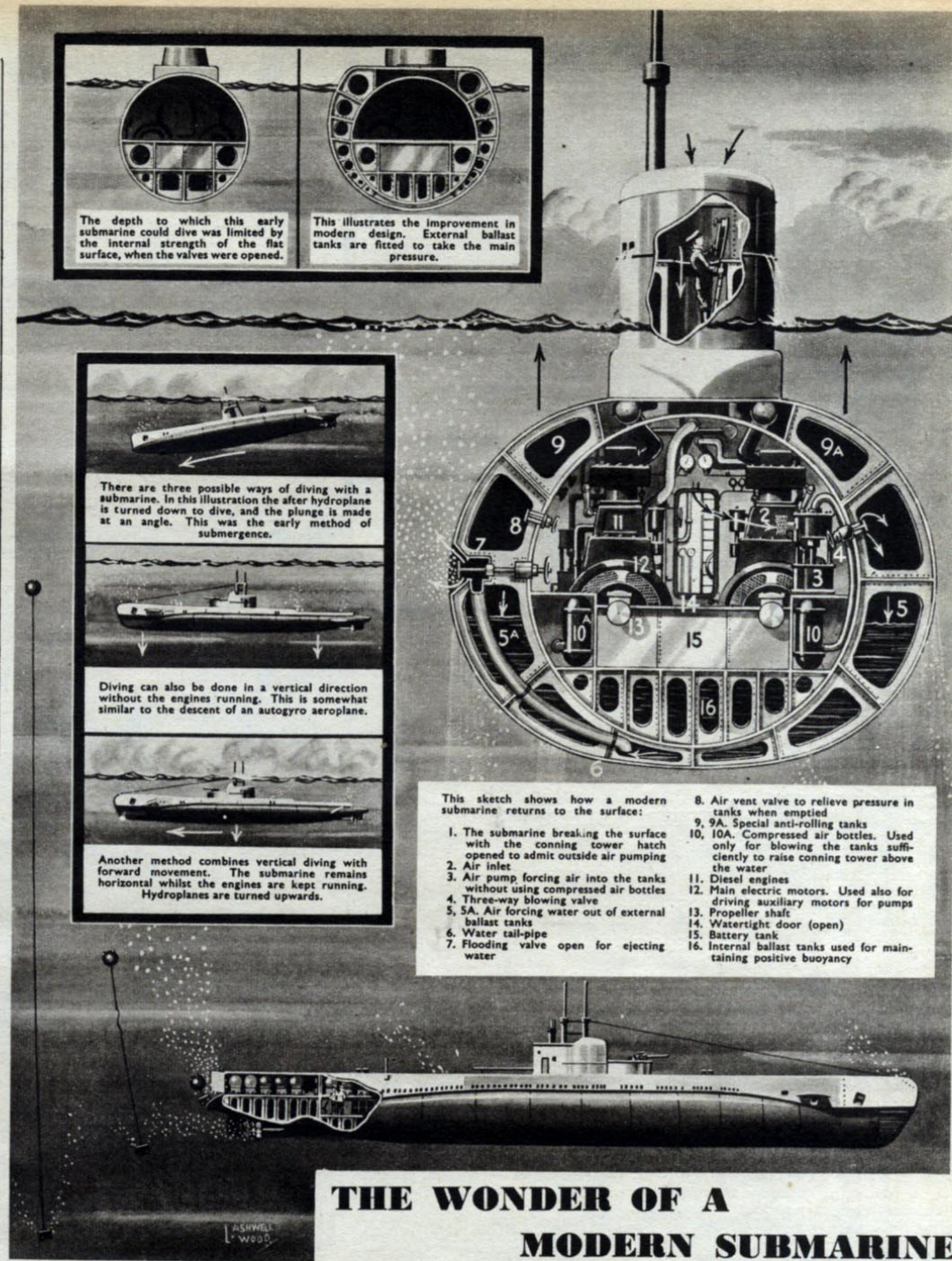
"Splendid!" Sir Walter thrust his hands deep into his pockets and smiled cheerfully at the company. "If he is a scout for the men who abducted Redpath, we will make use of him. Is there a public call box near here?"

"There's one some sixty yards along the Embankment. Why do you ask?" replied the detective.

"Because I am certain that he will phone through to his gang as soon as he finds out anything. And so, super, I shall be obliged if you will get on to the exchange and use your influence to have all calls tapped on that line for the next quarter of an hour."

"When you have fixed that, send a couple of your plain-clothes men for a little walk along the Embankment and tell them to pass that fellow near enough for him to hear what they are saying."

The detective shrugged his shoulders. "I suppose you know what you are up to,"



THE WONDER OF A MODERN SUBMARINE

he said as he picked up the telephone. "But I'm hanged if I get the idea."

Sir Walter laughed. "Quite simple, I assure you. I am convinced that Redpath has been taken off by boat—it would be much safer than using a car."

"Very well, then; let the patient gentleman down yonder hear your fellows say that we are convinced that the inventor has been taken away by car—they can say something about a stolen saloon having been found somewhere on the Great North Road—and he will probably hurry off to pass on the glad news of our stupidity."

"The telephone people must make a note of the number he calls up and the conversation that takes place, and report back to us here immediately. Then your men can collect him as he leaves and hold him on suspicion. Loitering with intent to commit a felony is a charge that will suffice to keep him in custody for a bit."

The following twenty minutes seemed to drag on leaden feet, but just as Leslie was giving up all hope of the ruse succeeding, the telephone bell rang and Superintendent Scarlyn made a dive for the receiver. For some moments he listened in silence, then, with a curt word of thanks, hung up and turned to the others.

"Your ruse succeeded, Sir Walter," he

said excitedly. "My men carried out your orders and the watcher promptly put through a call to the Hampton Wick district. The telephone people have located the place—it is one of those large old houses whose gardens back on to the river just below Teddington Weir."

"Teddington—Tide End Town, in other words," Sir Walter rubbed his chin thoughtfully. "Yes, that would certainly be a likely place. No locks to negotiate on the tidal water, and a fast motor-boat running without lights would have a good chance of making the journey unobserved."

"But tell me," he went on. "What was the conversation?"

The detective consulted the pad on which he had been writing as he listened to the telephone message. "It was as follows," he said. "When the caller was connected he said: 'W. One speaking. The busies are on the wrong track. They think you've headed north by road.' Then a man's voice at the other end said: 'Good. Report at once to Headquarters Three Scimitars district,' and rang off."

Sir Walter turned to Leslie. "Same type of instructions as were given in the Devon murder case," he rapped out. "Three scimitars are the Middlesex County arms. (Please turn to page 10)

THE sectional diagram of a modern submarine shown above, illustrates it at the moment it is coming to the surface. This position is known as positive buoyancy.

If all the air valves were closed and the motors started she would be ready to dive as soon as the flooding valves were opened.

In a modern submarine the method of breaking the surface is to blow compressed air into the main ballast tanks. Sufficient is blown just to raise the conning tower to the surface.

The hatch is then opened and fresh air is drawn in by the pumps which complete the blowing.

This method of blowing the tanks is very useful on large submarines as it saves the space which would otherwise be necessary for storing compressed air bottles. When you realize that some submarines have to eject as much as 525 tons of water ballast you will understand the saving effected.

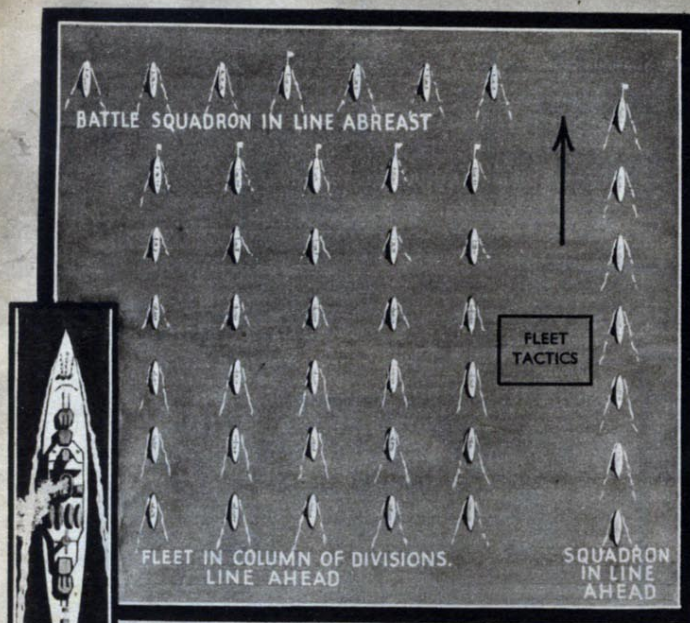
As the valve gear is complicated it is illustrated here in its simplest form.

(Bottom picture) The submarine in this illustration is shown laying mines. The mines travel along rails and are released through special trap-doors at the stern.

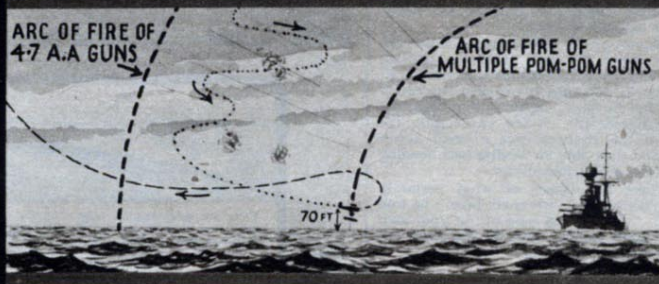
Mine-laying submarines are very useful for blockading harbours without the knowledge of the enemy.

THE NAVY IN A

THIS is Navy Week, and many readers will be going "behind the scenes" of the Senior Service. On these pages are illustrated some of the modern wonders of the Royal Navy. If you are fortunate enough to go over one of the new battleships, a study of the one pictured below will make your visit much more interesting.



Actual size of a battleship as seen from a bombing aeroplane at 6,000 feet.



AEROPLANE v. BATTLESHIP

Before a torpedo-carrying aircraft can discharge its torpedoes at a battleship it must come down to within 70-100 feet of the sea. If it were to drop them from a greater height contact with the sea would cause them to explode. The above drawing gives an idea of the arc of fire to which aircraft are subjected from a modern battleship.

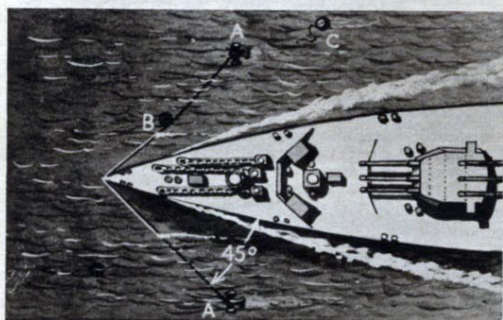
PRINCIPAL GUNS OF THE NAVY



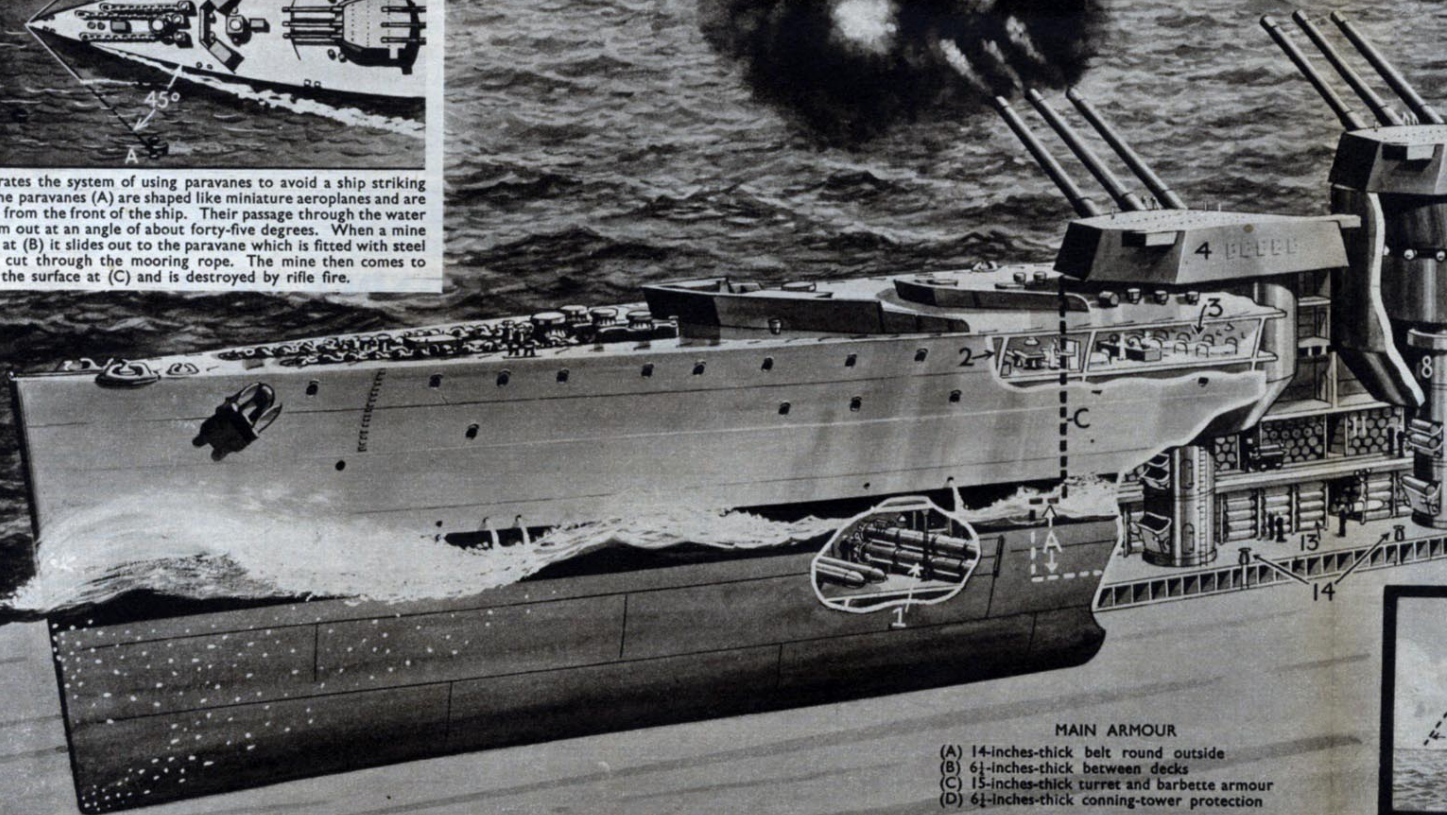
4.7 A.A.



50 ft



This illustrates the system of using paravanes to avoid a ship striking mines. The paravanes (A) are shaped like miniature aeroplanes and are suspended from the front of the ship. Their passage through the water keeps them out at an angle of about forty-five degrees. When a mine is trapped at (B) it slides out to the paravane which is fitted with steel teeth that cut through the mooring rope. The mine then comes to the surface at (C) and is destroyed by rifle fire.

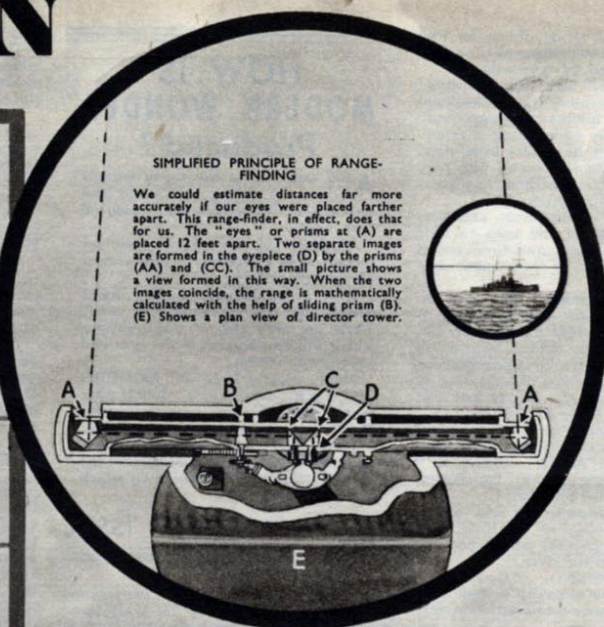


MAIN ARMOUR

- (A) 14-inches-thick belt round outside
- (B) 61-inches-thick between decks
- (C) 15-inches-thick turret and barbette armour
- (D) 61-inches-thick conning-tower protection

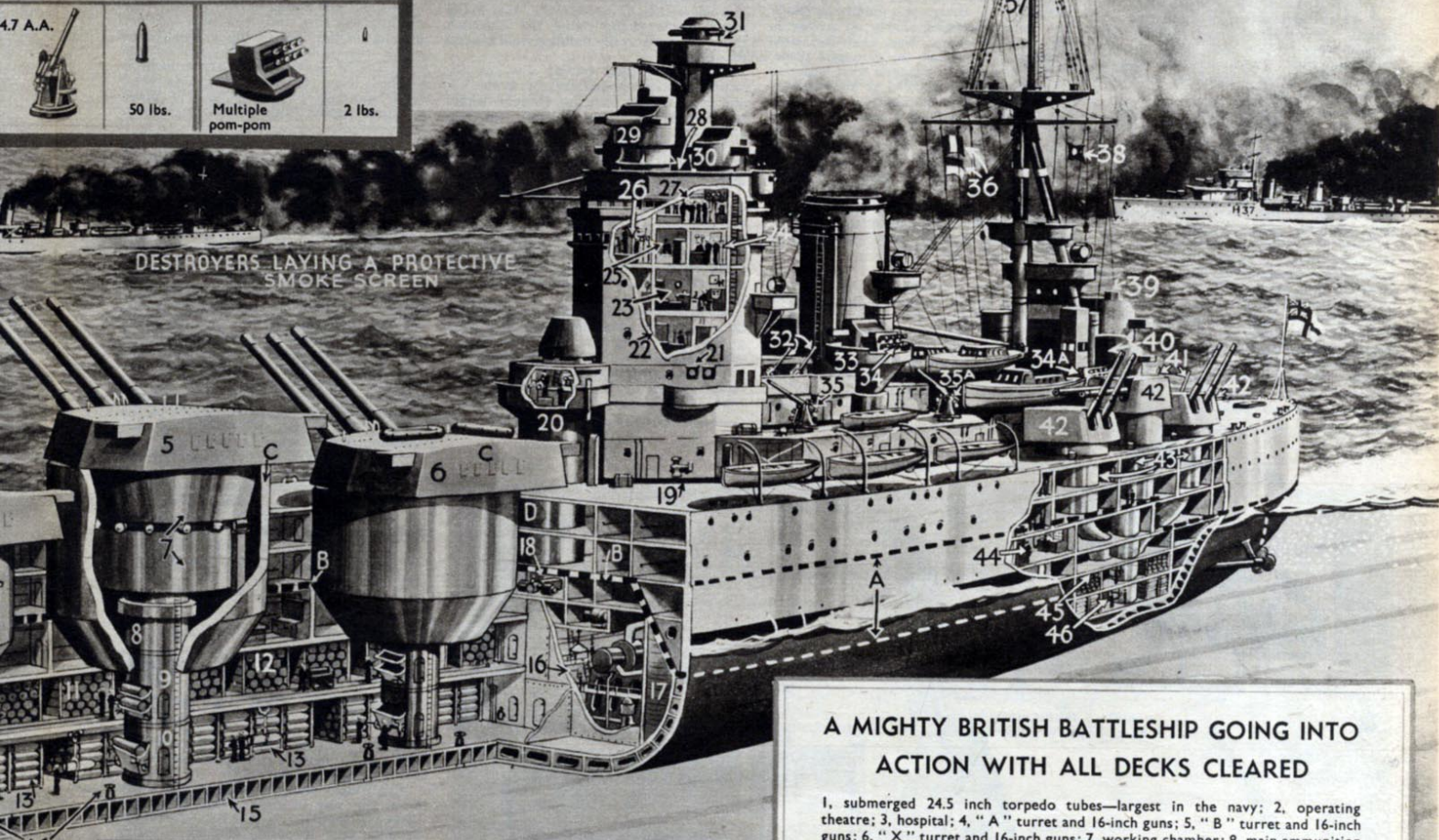
N ACTION

PRINCIPAL GUNS USED IN THE NAVY TODAY		WEIGHT OF SHELL
	16-inch	2,461 lbs.
	15-inch	1,920 lbs.
	8-inch	256 lbs.
	6-inch	100 lbs.
	4.7 A.A.	50 lbs.
	Multiple pom-pom	2 lbs.



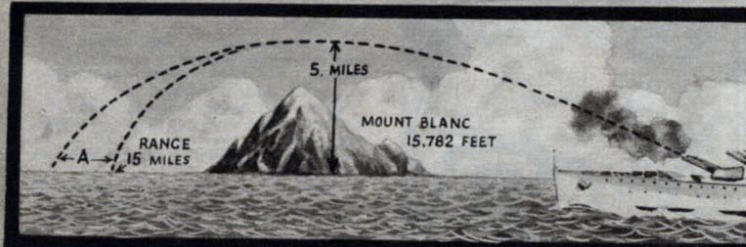
New type Fairey "Sea-Fox" spotting seaplane; 400 H.D. Rapier VI engine used for fleet co-operation.

The destroyers accompanying the battleship are laying a protective smoke screen. There is no specific number of these smaller craft forming an escort to the battleship, this entirely depends on the number of destroyers available.



A MIGHTY BRITISH BATTLESHIP GOING INTO ACTION WITH ALL DECKS CLEARED

1, submerged 24.5 inch torpedo tubes—largest in the navy; 2, operating theatre; 3, hospital; 4, "A" turret and 16-inch guns; 5, "B" turret and 16-inch guns; 6, "X" turret and 16-inch guns; 7, working chamber; 8, main ammunition supply shaft; 9, cordite tray; 10, shell tray; 11, handling room; 12, magazine; 13, shell room; 14, flooding valves; 15, double bottom; 16, port engine room; 17, oil fuel tanks; 18, protected steering connections; 19, paravane (stowed); 20, conning-tower—where ship is controlled when in action; 21, searchlights; 22, chief of staff sea cabin; 23, admiral's sea cabin; 24, admiral's chart room; 25, captain's sea cabin; 26, navigating bridge; 27, action room; 28, director control platform; 29, main director tower; 30, secondary director tower; 31, fire control top; 32, three-pounder guns; 33, torpedo director towers; 34 and 34A, multiple pom-poms; 35 and 35A, 4.7-inch A.A. guns; 36, "enemy in sight" and "open fire" signals; 37, wireless aerials; 38, helm signal indicator; 39, after main director tower; 40, after secondary director tower; 41, after 4.7-inch A.A. guns; 42, port 6-inch secondary guns (can be elevated to sixty degrees); 43, 6-inch gun trunks; 44, transmitting room where all ranges from director towers are given to turret control tops. Orders are also received from captain and fire directors and transmitted to their proper places; 45, 6-inch gun magazines and handling rooms; 46, 6-inch shell room.



THE RANGE AND TRAJECTORY OF A MODERN 16-INCH NAVAL GUN AND SHELL

(A) represents the effect of air resistance. The shell has a muzzle velocity of 1,800 miles an hour, and a rate of fire of one round a minute.

Modern Wonder

TWOPENCE
EVERY WEDNESDAY



MAP MAKING FROM THE SKY

The sectional view in the picture above shows the way in which the flying cameraman takes his photographs from the air. Aerial photography has improved rapidly during recent years and what was originally something of a hit-or-miss affair has now become a highly scientific business. The four red lines that run to the ground from the aeroplane on the left of the picture denote the area covered by the camera, the white lines show how each photograph overlaps the preceding one by about 60 per cent in a forward direction. These strips also overlap their neighbouring strips by about 30 per cent.

ALSO IN THIS ISSUE: SCIENCE AIDS THE EXPLORER • MAKING OF GIANT PROPELLERS and many fascinating features



MAP MAKING from the SKY

EXACTLY eighty years ago, a Frenchman named Nadar made history by taking the first aerial photograph while up in a balloon.

And such a sensation did his achievement create that all the newspapers printed long stories about it, while one Paris paper published a cartoon entitled "Elevating Photography to the Heights of Art."

But, both aeronautics and photography have gone far since that day, and now aerial photography is no longer a "hit-or-miss" affair but a very exact science.

And it is a very important one, too, as Squadron Leader P. R. Burchall, O.B.E., former Photographic Officer of the Royal Air Force and now in charge of survey operations for Aerofilms Ltd., emphasized in a recent interview with MODERN WONDER'S Special Representative.

Air photographs, he explained, are not just a means by which attractive "bird's-eye view" pictures can be obtained.

The vertical photograph, taken by a camera that protrudes through a hole in the floor of the plane, does not possess the attractive pictorial qualities of the oblique photograph which is taken at an angle of from 35 to 60 degrees, but it is invaluable in survey work.

It enables mapping and revision to be carried out rapidly and accurately and provides more detailed information than can ever be given on a map.

On the other hand, the oblique aerial photograph with its wealth of easily understandable detail is of enormous value to authorities who require a pictorial record of existing conditions when planning new works, or offices, studying slum clearance

in congested areas, recording the progress of works under construction, and so on.

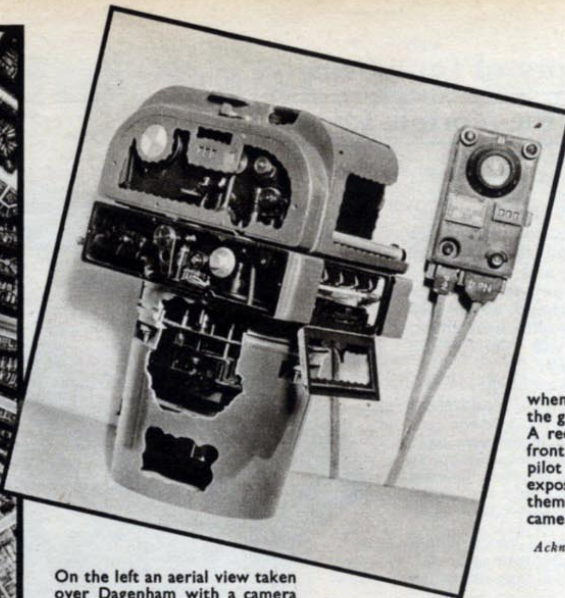
Lawyers, too, often find oblique aerial photographs of great use when arguing legal matters in the Law Courts, while as a form of pictorial advertising they are becoming more and more popular.

Vertical photographs are taken by a



Acknowledgement Aerofilms Limited.

Rough prints are immediately prepared from the negatives and are assembled, as shown, to check up the area covered. If there is any gap through interrupting cloud or other reason, a record is made on the flying map and further photographs are taken on the next fine day.



On the left an aerial view taken over Dagenham with a camera of the type shown above.

AIR SURVEY CAMERA

This shows the air survey Eagle camera with main control box. You will note that the body has been cut away to show the working parts.

It is automatically controlled and electrically operated. Exposures are automatically made by a time interval, which is ascertained by the navigator or photographic observer,

when estimating his speed over the ground.

A red warning light appears in front of the photographer and pilot two seconds before the exposure is made, to enable them to level the aircraft and camera.

Acknowledgement Aerofilms Limited.

special camera that is electrically controlled and automatic in action. It is supported on the floor of the plane in a mounting that absorbs all vibration while a specially designed "louvre" shutter ensures that the pictures will be free from distortion.

Before the pilot and photographer—Aerofilms employ almost exclusively former members of the Royal Air Force—go up on a survey flight, the exact route to be taken and the height at which they are to fly are worked out in detail.

The scale of the photograph and the amount of area covered is controlled by the height of the plane and focal length of the lens used, the most usual being a height of nine thousand feet with a twenty-inch lens, as this gives a scale of approximately twelve and a half inches to the mile. These conditions are used when work is being carried out on the revision of twenty-five inch ordnance sheets.

After each exposure, the film in the camera, measuring one hundred and sixty-five feet, and capable of taking two hundred photographs, is automatically moved forward, a special timing apparatus ensuring that at least two-thirds of the ground shown in one photograph is included in the picture taken immediately after it.

Inside the camera are a small clock, an altimeter and a Veeder counter set in a line in such a way that when each exposure is made, the light from a two-volt lamp enables them to be photographed on the margin of the picture. By this means it is possible to record the exact time of day at which each photograph was taken, the flying height of the plane, the serial number of the picture, and when necessary, cross-levels.

The "louvre" shutter, which consists of a row of very thin metal leaves which turn on end in exactly the same way as do the wooden bars on the old-fashioned Venetian blind, is first wound up. Then, two seconds before it is released, a red light flashes to warn the pilot to level up the plane.

The instant the photograph has been taken, a green light signals the "O.K." and the film is automatically wound over ready for the next exposure, by means of a small electric motor and electric control box.

The pilot engaged in aerial photography flies his machine along a series of parallel straight lines in such a way that about a third of the ground that appears on one side of the photographs taken on the first "run" will appear in those taken on the second, and so on.

He is provided with special instruments including a gyroscopic compass and a drift sight and from his map he picks out certain distinctive points beyond the imaginary straight line along which he must fly, and by taking a compass bearing on it, he is enabled to keep a straight course.

The greatest problem that confronts the pilot is a strong side wind, for this produces "crabbing." That is to say, the plane is being continually forced sideways at the same time as it is moving forward.

To counteract this effect, the camera is swung round to allow for the angle of drift and let the edges of the photographs run

parallel. The photographer checks up the actual direction of his flight by means of a special sight which is also used to estimate the angle of the plane's drift.

Within a few hours of a flight having been completed, the films are developed and then rough prints are made and assembled so that the area that has been photographed can be checked accurately.

This work is always carried out as soon as possible so that in the event of some part of the area having been missed owing to low cloud or faulty navigation, the gaps can be filled in by further photography on the next day.

In studying the aerial photographs, the stereoscope is used extensively, for by its means the ground may be studied in three dimensions. When you look at a pair of aerial photographs through a stereoscope, trees, buildings, hills and other objects seem positively to stand out from the picture in such a way that you feel you are not looking at a flat picture but a perfect scale model of the actual country.

As accuracy is the essence of survey, the photographs are enlarged and rectified optically until an exact fit with the ordnance map is obtained.

NEW TRAILER PUMPS FOR A.R.P.



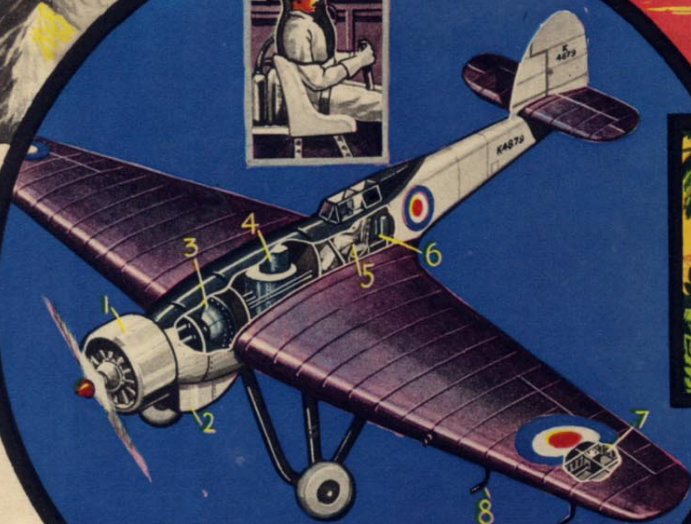
This new type of trailer pump is to be used by the Auxiliary Fire Service. Recently the L.C.C. took delivery of some fifty special vans that will be used to tow the trailer pump and also house its crew. This pump is being coupled to one of the vans at the London Fire Brigade Headquarters.

SCIENCE AIDS THE EXPLORER

Miles above the earth the aeroplane climbs dizzily on its attack on the altitude record; into the uncharted vastness of the stratosphere soars the balloon with its gondola packed with scientific instruments. Far below the sea the bathysphere explores the wonders of the ocean bed, and in the frozen wastes of the poles, in the humid, fever-ridden jungles of the tropics and the arid deserts, scientists by their skill are making the work of the explorer more important.

EXPLORING EVEREST FROM THE AIR.

The machine in which an important survey flight was made over Mount Everest and back. Details shown on the machine are: 1, Bristol Pegasus engine; 2, engine-driven generator; 3, 34-gallon petrol tank; 4, oil tank; 5, 67-gallon petrol tank; 6, pilot; 7, electrically driven and heated camera; 8, observer; 9, instrument control board; 10, observer's cockpit; 11, accumulator; 12, three oxygen bottles; 13, spare oxygen bottle.



The R.A.F. machine used for altitude record-breaking. 1, special Bristol Pegasus engine; 2, cooling radiator; 3, blower; 4, petrol tanks; 5 and inset, pilot in special high altitude suit; 6, oxygen cylinder; 7, official, sealed barothermograph; 8, air speed indicator.



One of the wonderful new caravan trailers built for the explorer, Commander Attilio Gatti, for use in the African jungles. Costing about £3,700 it is fitted with special air-conditioning plant, electric refrigeration and includes a bathroom and kitchen.

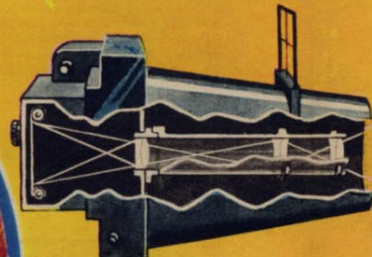
This motor-driven tractor sledge was specially designed for use in the ice fields of the Arctic and Antarctic, and its use dispenses with dogs.



A remarkable caterpillar tractor used for cinematography in the jungle. The camera is mounted on a periscope protruding from the circular conning tower in the front of the machine, and near the back is a powerful searchlight.



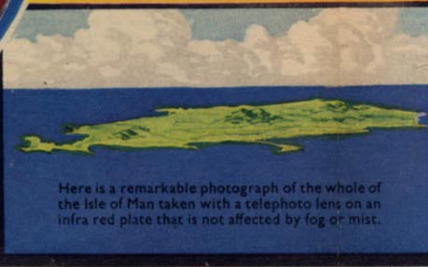
Natives of a bush village in the heart of Rhodesia generating power for a short-wave radio station. They are mounted on a small wooden platform the fittings of which resemble a tandem bicycle, and by pedalling they work the electric generator. Speed voltmeters fitted to the handlebars indicate the rate of pedalling required.



The illustration above shows the difference in focal length between an ordinary camera lens and one with a long telephoto lens placed in front of it. The telephoto lens, by magnifying the object, makes it appear nearer than it really is.

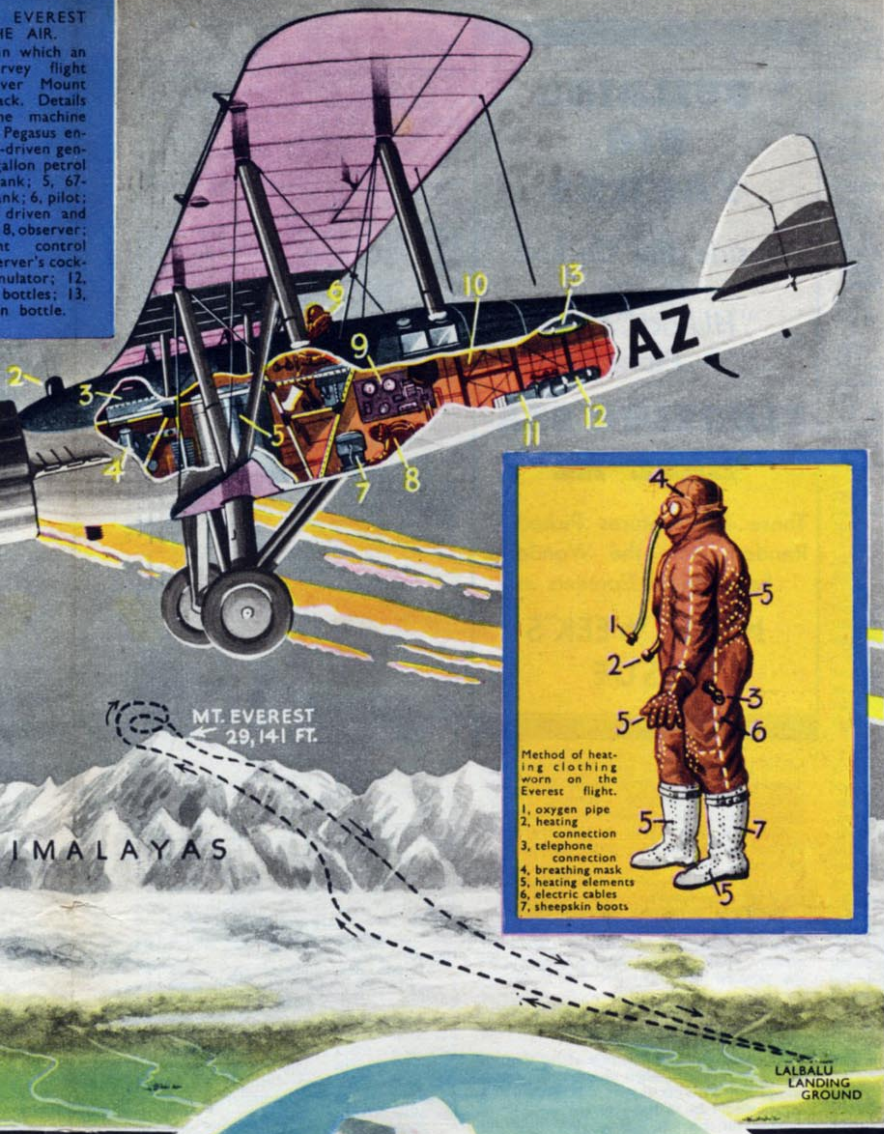


The new Russian long-distance monoplane for travelling over snow wastes and capable of landing on water or land. It is fitted with a 950 h.p. engine.



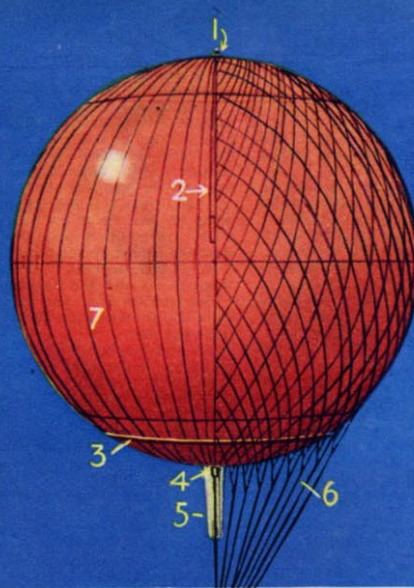
Here is a remarkable photograph of the whole of the hump of a whale taken with a telephoto lens on an infra red plate that is not affected by fog or mist.

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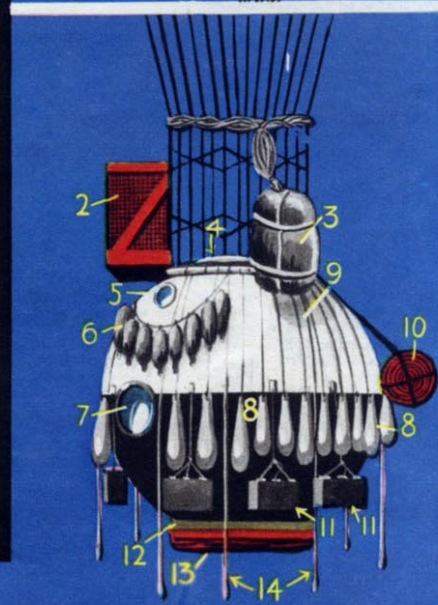


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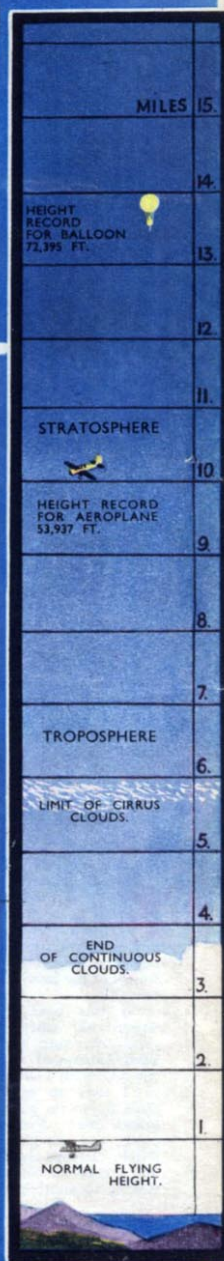


Details of envelope of stratosphere balloon. 1, valve for releasing gas; 2, ripping panel for use when landing; 3, rain gutter; 4, ripping line; 5, neck of envelope; 6, net; 7, envelope.

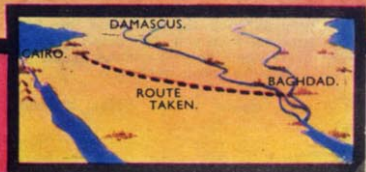


Details of the rig of a stratosphere balloon. 1, shrouds; 2, spectrograph basket; 3, parachute; 4, top porthole; 5, vision porthole; 6, equipment parachute; 7, manhole; 8, lead dust ballast; 9, gondola; 10, drag rope; 11, battery boxes; 12, inflated bumper; 13, deflated bumper; 14, hand ropes.

(Right) A scale in miles showing how far man has been able to ascend into the stratosphere with the aid of scientific equipment.



(Above) One of the huge Diesel-engine, 50 h.p. motor buses that cross the Syrian Desert, a distance of 530 miles, in from fifteen to eighteen hours. (Above, left) The famous submarine Nautilus in which Sir Hubert Wilkins will explore the Polar regions. It is fitted with an echograph.



Modern Wonder

EVERY WEDNESDAY

TWOPENCE

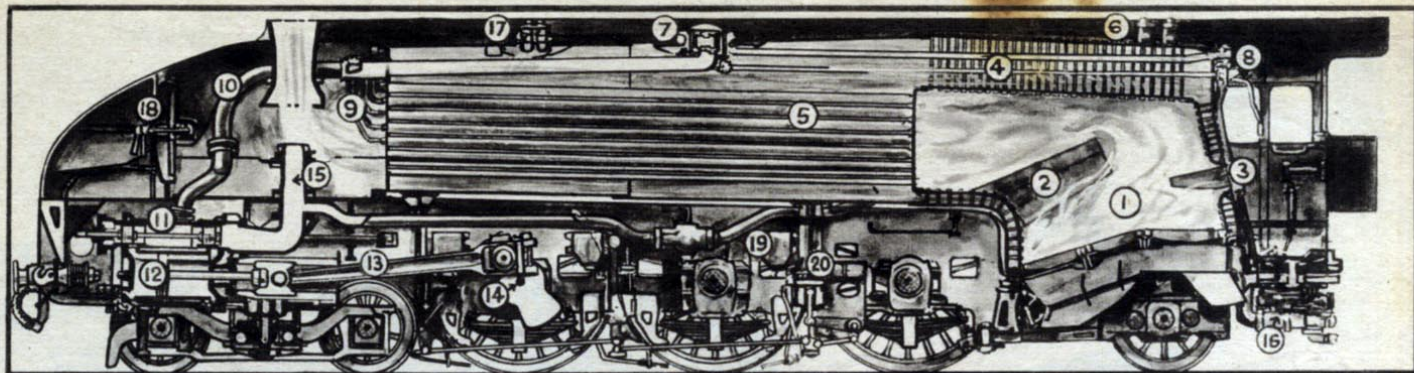


AN ENGINE DRIVER HAS TO KNOW ALL THESE CONTROLS

On the Footplate of the *Cheltenham Flyer*,
Britain's fastest scheduled Loco.

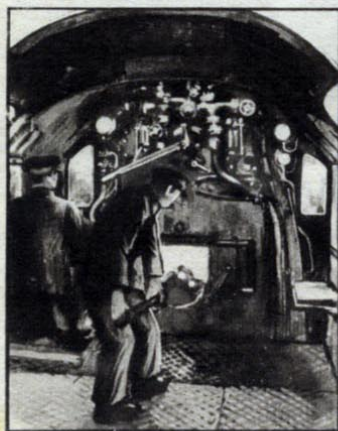
- | | | |
|-------------------------------|----------------------------------|--|
| 1. Tender water gauge | 9. Steam heating pressure gauge | 17. Blower valve |
| 2. Water pick-up scoop handle | 10. Boiler steam pressure gauge | 18. Regulator handle |
| 3. Fireman's tip-up seat | 11. Steam heating valve | 19. Lubricator |
| 4. Coal watering cock | 12. Exhaust injector steam cocks | 20. Reversing handle or valve control |
| 5. Damper controls | 13. Right hand injector (steam) | 21. Automatic track circuit warning bell |
| 6. Flap plate | 14. Vacuum gauge | 22. Driver's tip-up seat |
| 7. Firehole doors | 15. Ejector steam valve (brakes) | 23. Sanding gear levers |
| 8. Water gauge | 16. Ejector air valve (brakes) | 24. Tender hand brake lever |

See the story inside: "IF YOU WERE AN ENGINE DRIVER"



IF YOU WERE AN ENGINE DRIVER

This is what you would have to do to drive Britain's Crack Loco's



The spacious driving cab of the Coronation Scot. The fireman has to be very careful with his coal, 6½ tons must suffice for the 401 mile journey

MOST of us remember a time, during our school-days, when we knew no ambition so noble or so great as to become an engine driver.

I shall never forget my delight and pride when the driver of a little tank engine, on a local line, gave me the run of the tiny engine shed, showing how his engine worked, and actually taught me, a ten-year-old, how to drive her—after a fashion!

It seemed an easy step, then, from starting and stopping that ancient shunting locomotive, to driving a huge express at eighty glorious miles an hour. Yet, it's really a far longer step than most people imagine. Nobody can become an engine driver on the railway, straight away.

In America, the man who drives a locomotive is called, not a driver, but an engineer, and this is a much more fitting title than ours, which we inherit from stage-coach days. He is an engineer, a highly specialized, practical engineer.

The young man—at first he is a boy in his 'teens—enters the locomotive department of a railway as a cleaner. And that consists of much more than helping to give each locomotive a tidy rub-over when it comes home to the steam shed, at the end of its day.

As a cleaner the young man learns, in the course of his duties, exactly how a locomotive works; the significance of every part of it; and, all the peculiar ailments to which it is prone.

Eventually, as a "passed cleaner," the budding driver has his first experience of firing—on a shunting locomotive to begin with. And, little by little, he rises through the various grades of firing until he becomes fireman to a driver in a crack passenger "link."

And, being a fireman doesn't consist simply of keeping the fire going, though that in itself is a science; a strenuous science based on the axiom, "little and often."

Just as a cleaner has to be a potential fireman, so does a fireman have to be a potential driver.

If a driver is taken ill or otherwise incapacitated during travelling, the fireman

must be ready and capable of taking over from him the entire responsibility for the train.

As it is, his normal duties consist of keeping a good bright fire, all the time; of watching the water gauge, and replenishing the boiler when necessary; of watching the pressure gauge—if he lets the pressure fall at an awkward time, and most times are awkward, he hears about it—and whenever possible of assisting his driver in the continuous work of keeping a look-out.

No lazy man's job is that of the engine-man, and no weak man's either. The fireman must observe constant economy, without letting the fire down.

A locomotive gets through an astonishing quantity of coal, but the driver of the *Coronation*, for example, doesn't want to have to come off at Berwick or some such place because there is no more coal in the tender.

A similar watch must be kept on the water. Watering the engine at terminal and wayside stations, or from track water troughs, is the fireman's job.

Something may be running hot, and the fireman may be sent along the running-plate of the roaring, plunging, engine with his oil-can, to rectify it as best he can.

And long years after the youthful

applicant entered the service as a cleaner, he finds himself a "passed fireman," on the threshold of drivership.

Then, once again, he starts at the bottom. First on a shunting engine in some yard. And, a long time must elapse before he finds himself in the top link, handling the fastest and most important trains.

Driver and fireman must work as one man, yet with the driver's command as unquestioned as that of the captain of a ship. The driver must know his locomotive so well that he feels himself a part of it—its brain.

Also he must know the road as he knows his own house, whether by day, or on a pitch-black, rainy, night. When working over a strange route, the two men on the footplate will be accompanied by a pilotman, who is perfectly familiar with it.

Learning the road, in this way, comes in the course of the man's duties as a fireman.

In some ways, locomotives resemble intelligent beings. Fifty may be inwardly and outwardly identical, yet, each will have its own vagaries, and in a series of standardized engines one may yet be a "black sheep," for no apparent reason.

Just as a jockey must nurse the strength and staying power of his horse, so must the driver know exactly how to conserve

KEY TO SECTION ABOVE

- 1, Fire-box and grate; 2, brick arch; 3, fire-hole door and deflector plate; 4, fire-box crown stays; 5, boiler and superheater tubes; 6, four safety valves; 7, dome, steam-pipe and regulator; 8, regulator handle; 9, superheater; 10, steam-pipe to cylinders; 11, valve chest; 12, piston and cylinder (four sets); 13, connecting rod; 14, crank axle; 15, exhaust blast pipe and chimney; 16, exhaust injector (boiler feed); 17, clack valve (boiler feed); 18, smoke box door; 19, sand boxes; 20, steam brake cylinder.

the power of his locomotive. There is far more in it than in driving a motor vehicle.

It would never do for a driver to open his regulator wide on approaching a long gentle downhill stretch, with the wind behind him, and after an exhilarating excursion into the realms of over a hundred miles an hour, to find himself faced with a long climb and no steam left. In the days of small boilers that was not altogether uncommon, all the same.

Just as the fireman has methods of "coal dodging," so has the driver means for "steam dodging," or getting the most work out of a given quantity of steam.

He can conserve steam by varying his cut-off, or the point at which his valves cease to admit steam to the cylinders, on each stroke of the piston.

With his hand on the regulator, his eyes are constantly on the road ahead, ready to pick up in a flash, every signal concerning his train, or anything unusual on the permanent way itself. Whatever happens he must be ready to act instantly. His mind and his hand must act simultaneously.

TAKING THE HARD WORK OUT OF ROAD RAMMING

This machine, the Johnson Balanced Pressure Road Rammer, is, in fact, an internal combustion engine.

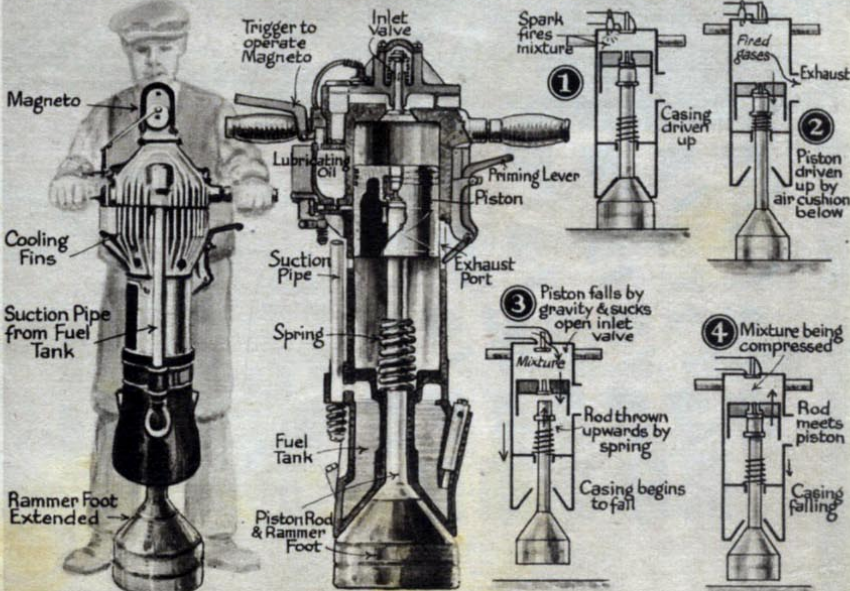
The centre drawing shows a section of the machine, with all at rest. Sketches (1) and (2) illustrate it diagrammatically. When the lever under the right-hand handle is pushed down and released, the piston lifts and drops, and draws benzole vapour into the cylinder.

As soon as the ignition trigger is pulled down, on the other handle, a spark fires the mixture. The gases force the casing upwards, until the exhaust ports are opened, when most of them escape.

A cushion of compressed air throws the piston upwards.

Now, the piston falls by gravity, and in sketches (3) and (4) a charge of air and benzole vapour is being drawn through the open inlet valve. Meanwhile, the piston rod is thrown up by the spring below it, and meets the descending piston. This reverses its direction. The casing also is falling, and as piston and piston are rising, the mixture is compressed.

The left-hand sketch shows the rammer foot extended ready for the jump, which is about two feet.



FAMILIAR SIGNAL FLAGS SEEN ON A CRUISE



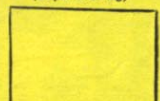
"BLUE PETER"
(Departure Flag)



"PILOT WANTED"



"PILOT ON BOARD"



"CLEAN BILL OF HEALTH"



"DISEASE ON BOARD"



"LOADING EXPLOSIVES"



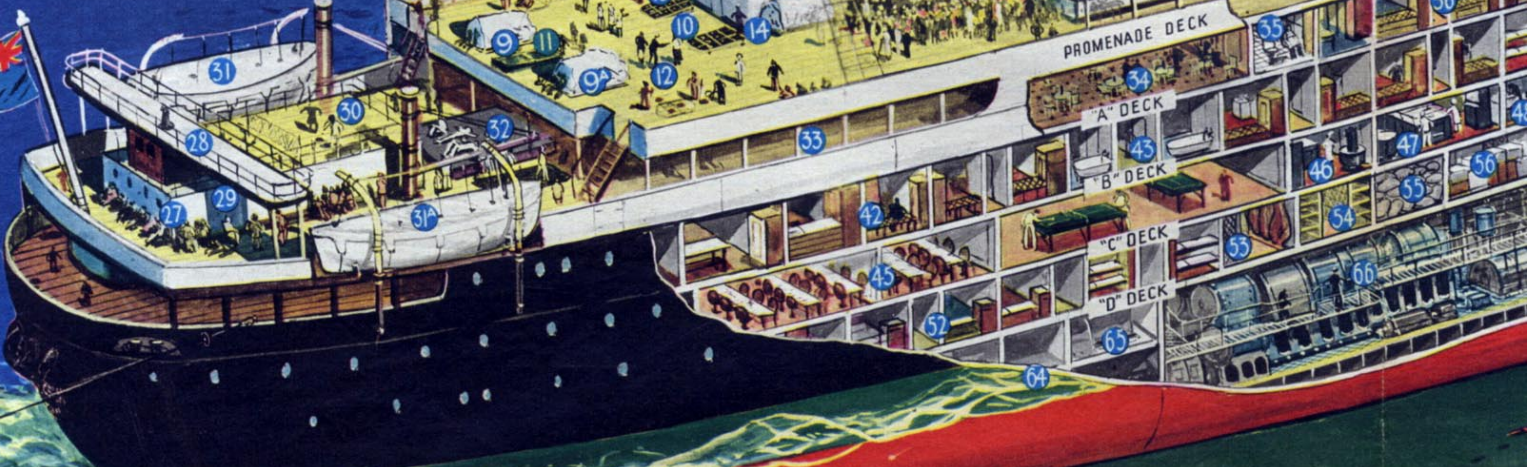
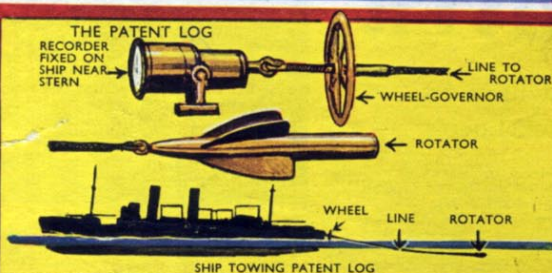
"YES"



"NO"



ANSWERING PENDANT



CANADIAN PACIFIC UNIFORM REGULATIONS

1, Captain and staff captain; 2, chief officer; 3, first officer; 4, second officer; 5, junior officers; 6, chief engineer; 7, assistant chief engineer; 8, second engineer; 9, third engineer; 10, fourth engineer; 11, junior engineer; 12, purser; 13, second purser; 14, senior surgeon; 15, junior surgeon; 16, assistant purser; 17, writer; 18, rail traffic representative; 19, chief steward; 20, second steward; 21, first electrician; 22, second electrician; 23, third electrician; 24, wireless operator; 25, senior plumber; 26, junior plumber; 27, boatwain; 28, boatwain's mate; 29, quartermaster; 30, carpenter; 31, carpenter's mate.

HOLIDAY CRUISE ON A MONT

ONE of the most remarkable changes in the holidays of the average Britisher of recent years is the great growth of foreign travel and the coming of the cruising holiday, available today for the man and woman of moderate means, who never before had a chance to see so much in a fortnight.

The glamour of the South, the beauties of Portugal, Spain (in happier days in that country), the Mediterranean, the Riviera, the glamour of Morocco and the beauties of the Atlantic Isles.

Or, if desired, the ocean holiday-maker can travel northward to see the scenic wonders of the Norwegian fjords, cruise in the calm Baltic, visit Helsinki in Finland, Oslo, Stockholm, Copenhagen, Zoppot, the Kiel Canal and Northern Germany.

The ship depicted in our illustration is one of the famous "Mont" ships of the Canadian Pacific Steamship Co., Ltd. (Canadian Pacific Railways), with whose kind co-operation and assistance the drawing was made. These ships are among the most popular of British cruising liners.

From the time that the passenger goes on board either at London (Tilbury), Southampton or Liverpool, he is looked after lavishly. He can have to eat anything he desires, he has skilled stewards to look after him. Sports of all kinds are provided and games are organized by special sports officers and a skilled cruise director. There are race meetings, cricket matches, aquatic sports in the pool, and, of course, dancing every evening.

Thus the lucky cruiser can see all the wonders of strange lands in the greatest comfort in a 16,000-ton liner.

The flags shown are very familiar to all cruisers as they are the most commonly seen of the flags of the International Code.

Various ships met with include liners, usually distinguishable by their size, their promenade decks and two, three or even four funnels.

The international ice patrol is undertaken by American gunboats and these are frequently seen during a cruise to the Mediterranean or the Atlantic Isles.

Motor ships in the majority of cases carry dummy funnels, but usually careful observation will reveal a jet of "fumes" coming up in regularly timed "puffs" from a small part of the dummy funnel, in fact, where the engine exhaust emerges.

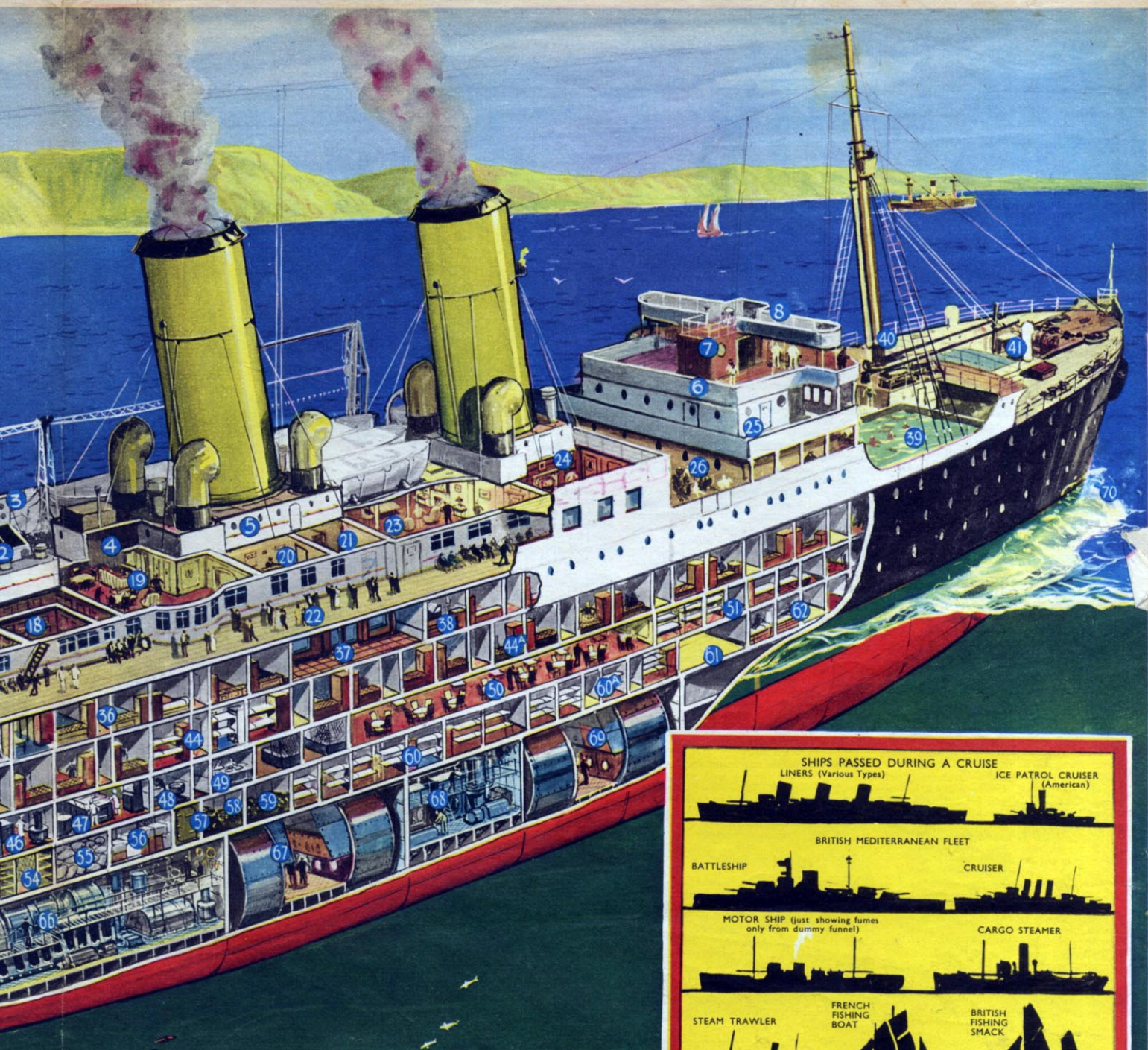
Cable ships are sometimes seen; they are noticeable by the big bow "sheaves" or wheel for handling the cables.

The measurement of the ship's speed through the water is essential in navigation (and also provides a daily gamble for the passengers). This is done by the log.

The instrument in commonest use today consists of the recorder mounted on the after tailrail and with a rotator trailing astern in the water at the end of a long "line". The rotation of the rotator is communicated by the line to the recorder, which records the speed and run of the ship.

Here is the key to the sectional view above:

BOAT DECK
1, Life-boats; 2, engine-room hatch; 3, motor life-boat; 4, raised roof of drawing-room; 5, wireless officers' cabins; 6, bridge; 7, wheel house; 8, flying bridge.



ON A MODERN LINER

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to the sectional view above:

BOAT DECK
 engine-room hatch; 3, motor life- of of drawing-room; 5, wireless bridge; 7, wheel house; 8, flying

PROMENADE DECK
 9 and 92, cargo winches; 10, sports deck; 11, deck golf; 12, shuffle board; 13, bull board; 14, quoits; 15, race meeting in progress; 16, main mast; 17, smoking-room; 18, cocktail bar; 19, drawing-room; 20, cruise office; 21, entrance; 22, dancing on covered promenade; 23, lounge; 24, writing room; 25, officers' quarters; 26, lounging and reading.

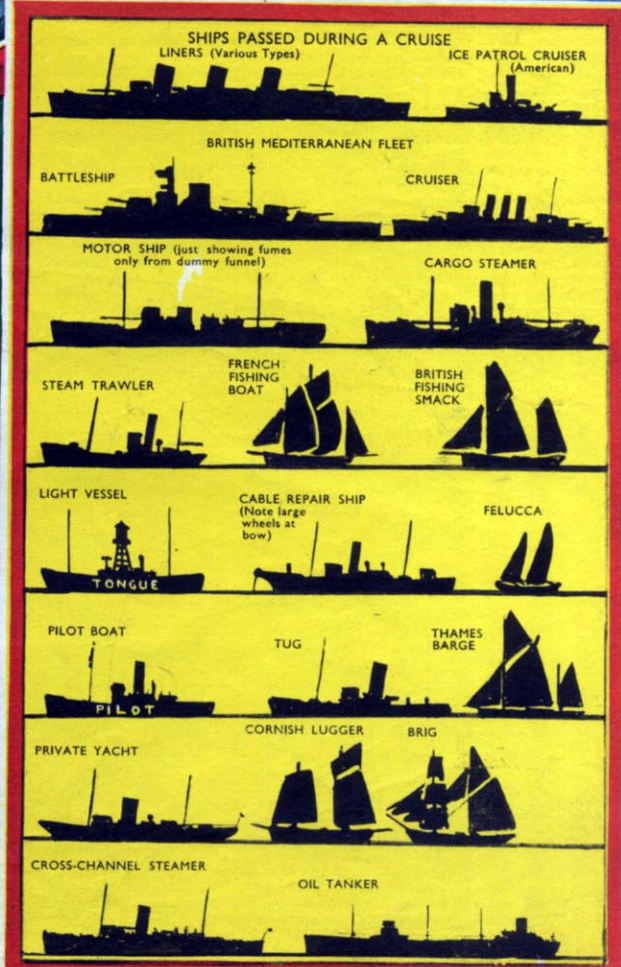
"A" DECK
 27, Passengers reading and sunbathing; 28, docking bridge; 29, hospital; 30, deck tennis; 31 and 31a, life-boats; 32, hatchway; 33, covered promenade; 34, reserve smoking-room; 35, barber's shop; 36, state-rooms; 37, main entrance; 38, purser's cabin and office; 39, swimming pool; 40, foremast; 41, forecable.

"B" DECK
 42, Staterooms; 43, bathrooms; 44 and 44a, staterooms.

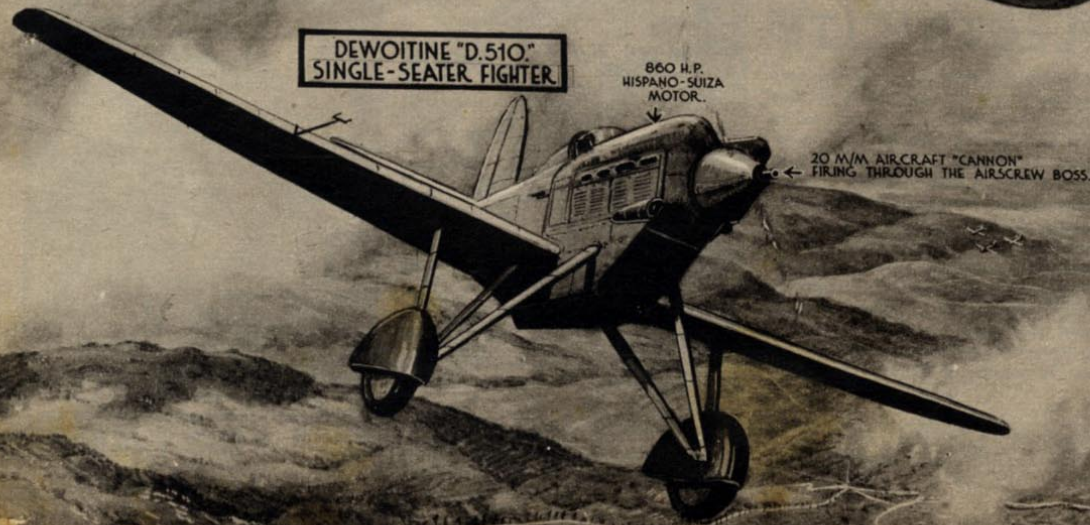
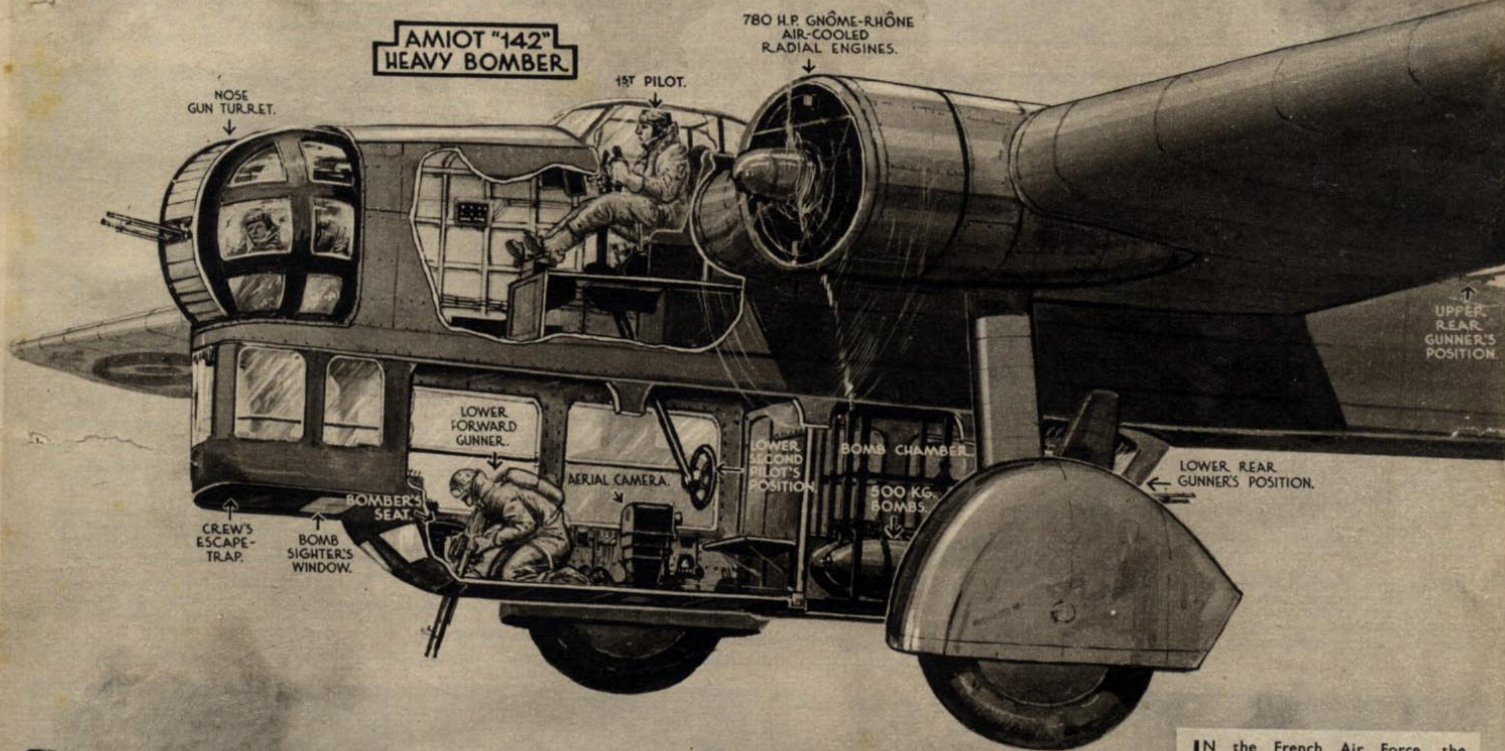
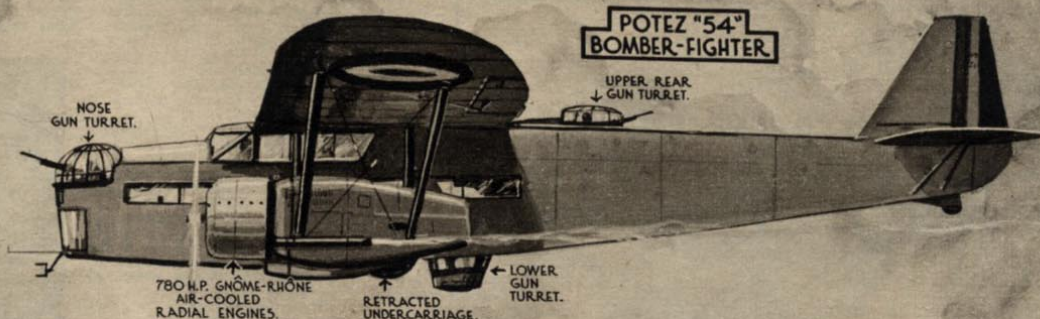
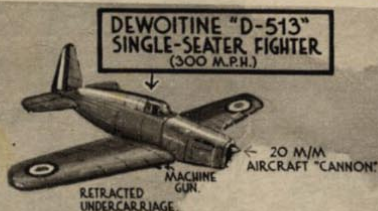
"C" DECK
 45, Reserve dining-room (in certain cases used for such sports as table tennis, etc.); 46, vegetable preparing room; 47, kitchens; 48, bakery; 49, serving room; 50, main dining saloon; 51, stewards' quarters.

"D" DECK
 52, Staterooms; 53, chill room; 54, fish and ice room; 55, flour room; 56, bulk store; 57, stores entrance; 58, coal store; 59, coke store; 60 and 60a, stewards and crew's accommodation; 61, open space; 62, cabins.

HOLD, ETC.
 63, Starboard propeller; 64, hull diagrammatically cut away to show interior; 65, fans; 66, starboard engine-room (geared turbines); 67, after boiler-rooms; 68, auxiliary machinery; 69, forward boiler-room; 70, bows.



FIRST-LINE MACHINES OF FRENCH AIR FORCE



IN the French Air Force, the standard unit is the "group" which comprises two escadrilles. Generally speaking, these formations are rather smaller than are our own R.A.F. squadrons. In recent months the development of the French air force has been pushed forward rapidly and now other powerful fighting planes than those pictured above have recently been added to its strength. In the spring of this year, France had about 2,000 machines on home service with another 550 in reserve, the Navy had 110 machines and a few in reserve, while the overseas strength was about 450 machines with 130 in reserve. Three dirigibles are also in commission. The total personnel is over 40,000 officers and men. The air force in France is divided up into four commands which have their headquarters at Metz, Paris, Lyons and Tours respectively. Both the Loire-Nieuport "46" Single-seater Fighter and the Dewoitine "D.510" shown in the above drawing reproduced by courtesy of the Illustrated London News, are provided with moteur-canon that make them very formidable planes.

Modern Wonder

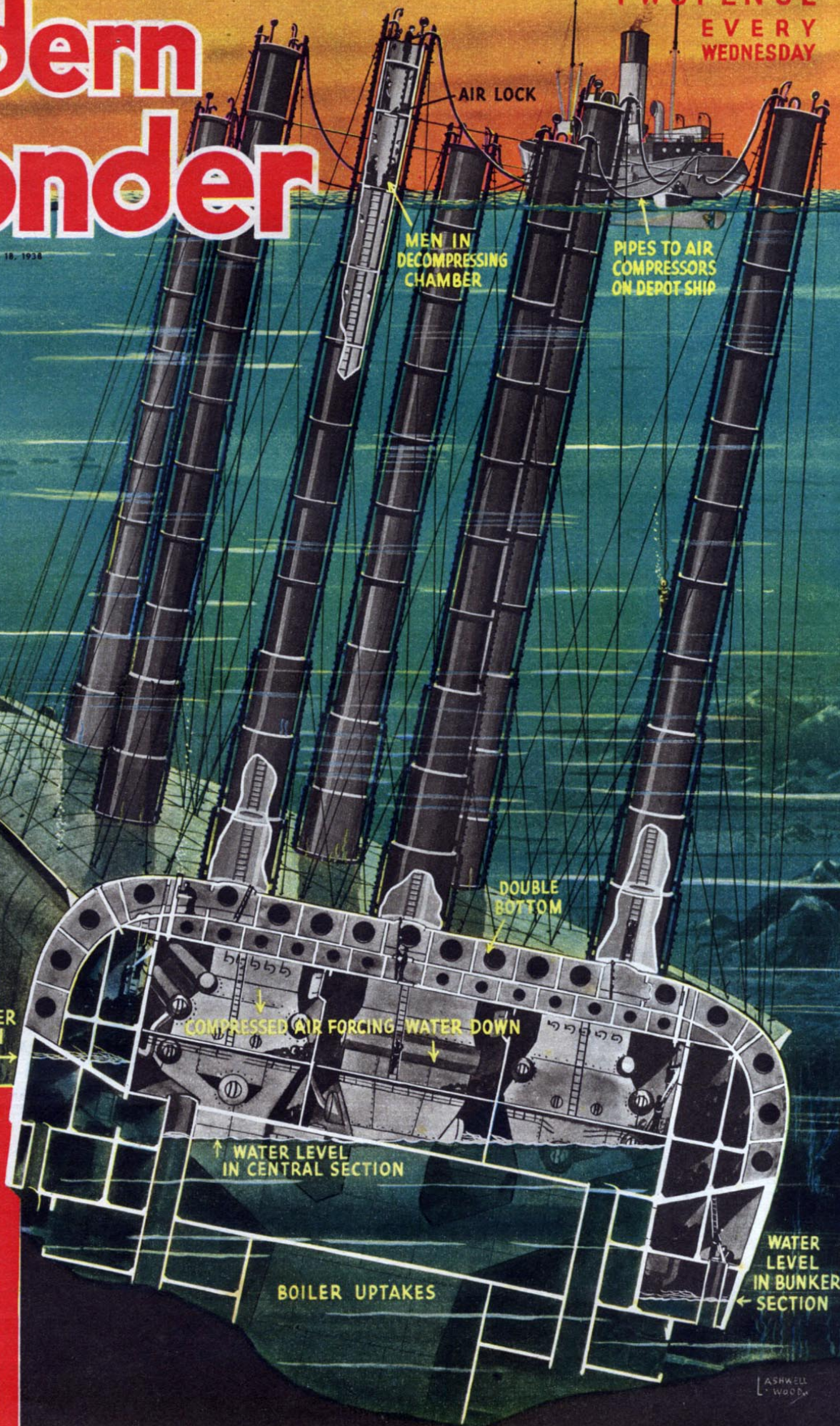
Vol. 3, No. 57, Week ending June 18, 1938

TWOPENCE
EVERY
WEDNESDAY

WATER
LEVEL
IN BUNKER
SECTION →

SALVAGE WORK AT SCAPA FLOW

WHEN the Germans sank their big battleships at Scapa Flow they sent them to the bottom upside down, thinking that by so doing it would be impossible to salvage them. But in fact, by doing this, they simplified the task of the salvage men. When divers have entered the sunken vessels they close valves and then long air locks are lowered to the upturned keel. These heavy steel tubes weighing about twenty tons each, are firmly fixed to the hull with bolts and braced with stay wires. The men working on the wreck pass down these huge tubes, going through air locks at regular intervals. When compressed air is driven through these tubes it gradually forces the water out of the wreck until men can work in it, breathing compressed air. By regulating the amount of air pumped into different sections, the wreck can be raised on an even keel. The full story appears overleaf.



ASHWELL
WOOD

AMERICA'S MIGHTY FIGHTING PLANES

CONSOLIDATED "P-30"
TWO-SEAT FIGHTER.
800 H.P. CURTISS "V" LIQUID-COOLED MOTOR.

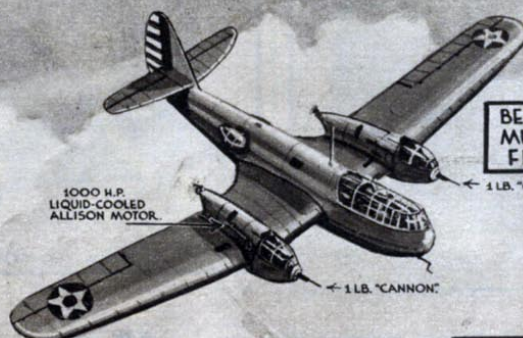


NORTH AMERICAN "XO-47"
THREE-SEAT OBSERVATION MONOPLANE
940 H.P. WRIGHT "CYCLONE" RADIAL ENGINE.



BELL "XFM-1"
MULTI-GUN FIGHTER.
1 LB. "CANNON"

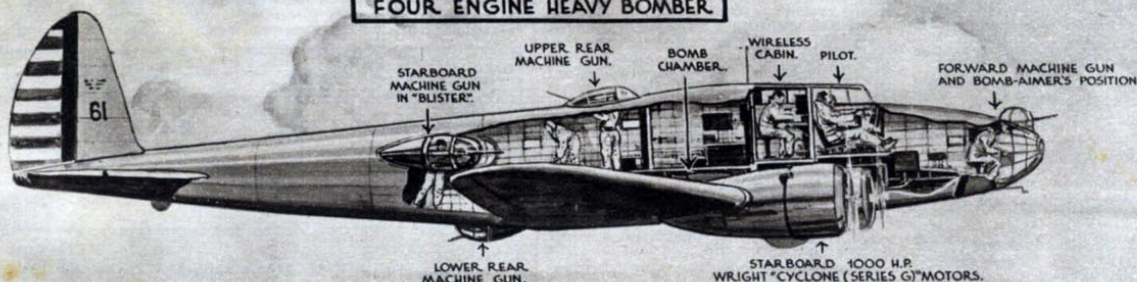
1000 H.P.
LIQUID-COOLED
ALLISON MOTOR.



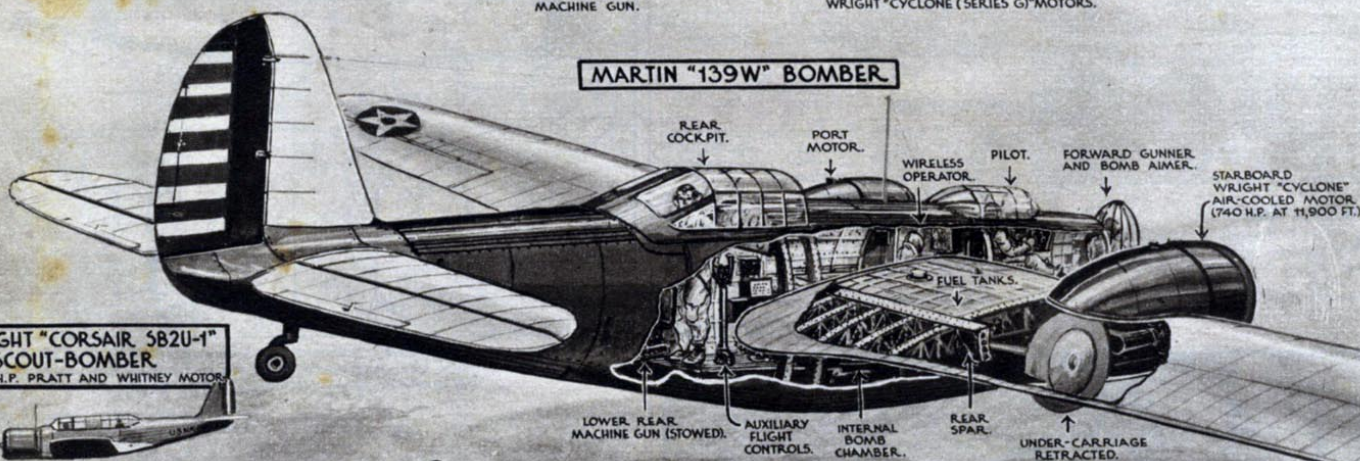
NORTHROP "BT-1"
TWO-SEAT DIVE BOMBER.
750 H.P. PRATT & WHITNEY "TWIN WASP JUNIOR" MOTOR.



BOEING "Y.B.17"
FOUR ENGINE HEAVY BOMBER.



MARTIN "139W" BOMBER.



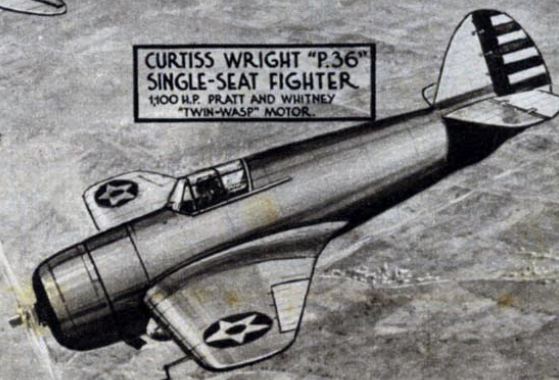
VOUGHT "CORSAIR SB2U-1"
SCOUT-BOMBER.
700 H.P. PRATT AND WHITNEY MOTOR.



SEVERSKY "P-35"
SINGLE-SEAT FIGHTER.
950 H.P. PRATT AND WHITNEY "TWIN-WASP" MOTOR.



CURTISS WRIGHT "P.36"
SINGLE-SEAT FIGHTER.
1100 H.P. PRATT AND WHITNEY "TWIN-WASP" MOTOR.



AMERICA maintains three independent Air Services which are known as the U.S. Army Air Corps, the U.S. Naval Air Service and the U.S. Marine Corps. Each of the Air Services buys its aeroplanes and motors separately, and the result is a great stimulus to competition among the manufacturing firms. In fact,

enormous progress in design and construction has been made during recent years, and in the picture above, reproduced by courtesy of the Illustrated London News, you can see some of America's latest types of aircraft. One of the most interesting is the Bell XFM-1 Multi-gun Fighter shown in the top right-hand corner. Its

chief function is to combat the high-speed bomber, and in addition to machine-guns mounted in streamlined "blisters," quick-firing cannons are placed forward in the two nacelles in the rear of which are the 1,000 h.p. Allison, glycol-cooled, 12-cylinder, super-charged engines with pusher air-screws. For some

time, the "Flying Fortress," the giant Boeing Y.B.-17 Heavy Bomber, with its four mighty engines, its 105 ft. wing-span and its five machine-guns was regarded as the last word in design and construction. But now, America has produced the Y.B.-15 which surpasses it, although details concerning it are still being kept secret.

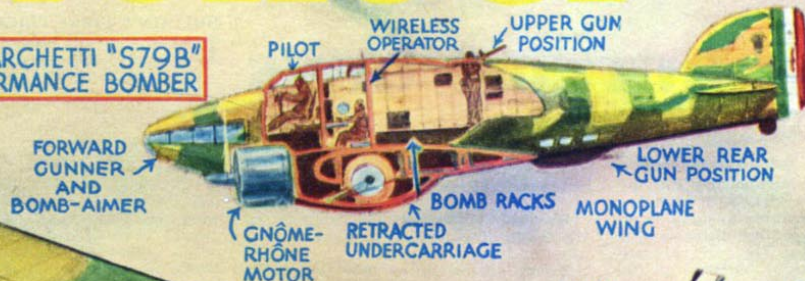
Modern Wonder

**TWOPENCE
EVERY WEDNESDAY**

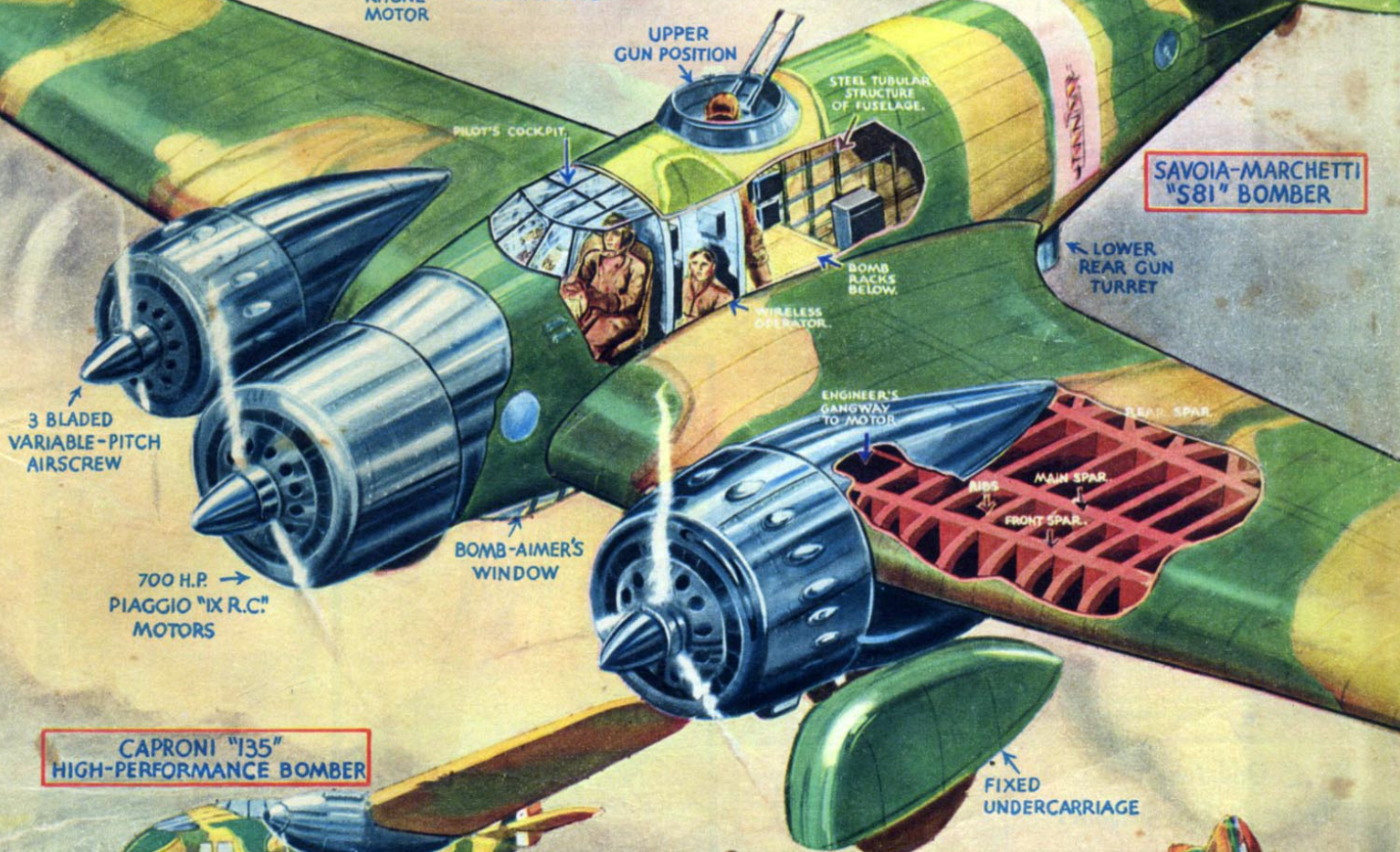
Vol. 3, No. 56. Week ending June 11, 1938

**MERIDIONALI "RO 37"
RECONNAISSANCE AIRCRAFT**

**SAVOIA-MARCHETTI "S79B"
HIGH-PERFORMANCE BOMBER**



**SAVOIA-MARCHETTI
"S81" BOMBER**



**CAPRONI "135"
HIGH-PERFORMANCE BOMBER**

2 VICKERS GUNS

**FIAT "G.R. 32"
SINGLE-SEATER FIGHTER**

**BREDA "88"
MULTI-SEATER FIGHTER,
OR BOMBER**

**BREDA "65"
LOW ATTACK AIRCRAFT**

**IN THIS
ISSUE:**

**THE ITALIAN AIR FORCE • ROADS OF THE FUTURE • WONDERS OF THE
MICROSCOPE • AIR NEWS • WORLD TOUR BY AIR • ODD JOBS OF THE FIRE BRIGADE**



A 90-CM
SEARCHLIGHT
This searchlight can
throw a beam to
20,000 ft.

- 1, Telephone wires from sound locator;
- 2, Ventilating fan;
- 3, Flue;
- 4, Parabolic reflector;
- 5, Positive carbon;
- 6, Negative carbon;
- 7, Carbon rotating gear;
- 8, Carbon counter-weight;
- 9, Control arm;
- 10, Control switches;
- 11, Hand-control rails;
- 12, Elevating control gears;
- 13, Support;
- 14, Caterpillar track unit;
- 15, 70-Volt-150-amps. supply cable.

IN DEFENCE ANTI-AIRCRAFT

OUR anti-aircraft defences have been so perfected that it would be very problematical whether enemy bombers could successfully attack London, or any other large city in England; indeed it is estimated that, at a minimum, twenty-five per cent of the attacking bombers would never reach home again, and this figure is very high for the losses of an attacking force for each raid.

We have six main methods of defence, all working in conjunction with one another: 1, Interceptor fighting planes; 2, Searchlights and sound-locator detachments; 3, Anti-aircraft guns; 4, Balloon barrages; 5, Communications; 6, Control system. On these pages we show in detail many interesting things about some of these methods. The work of defence begins far out at sea where trawlers radio the land control rooms on the approach of enemy planes. In addition the Observer Corps, consisting of thousands of watchers on the coast, will telephone immediately they sight hostile aircraft.

Pictorial map showing how London is very vulnerable to attack from north-west Europe. The distances shown are within easy flying range of the modern bomber. The new long-range aircraft of the R.A.F. could easily stifle attack at its source and the principal aerodromes in north-west Germany are shown with a cross.



(Left) An enemy plane entering any of our vulnerable areas can be passed on from searchlight to searchlight as it progresses. The conjunction of three beams shows the position and signals the attack for the interceptor fighters. The searchlight at A has "dropped off" the target and "passed on" to B, C and F. Shortly B and C will "drop off" and "pass on" to D and E. This system works in any direction.

ENGLAND

LONDON

AVERAGE
RANGE OF
MODERN Bomber

2,000 MILES

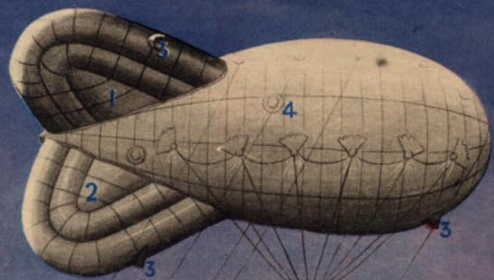
150 MILES

270 MILES

FRANCE

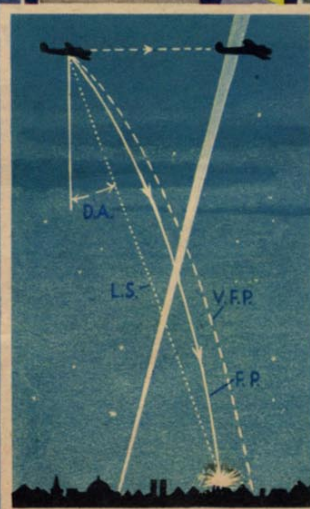
BELGIUM

HOLLAND



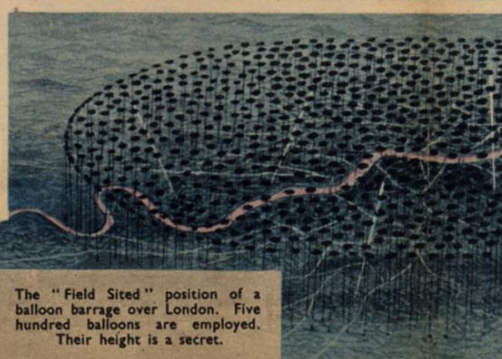
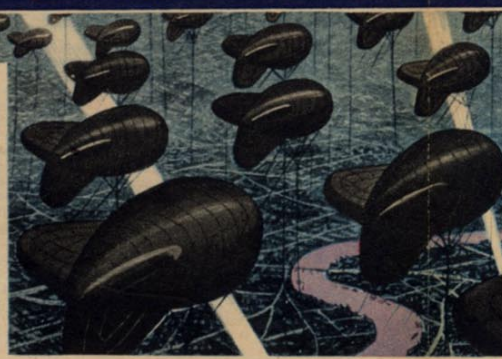
A BARRAGE BALLOON UNIT AT WORK

The balloons are carried on winch-lorries, and inflated from hydrogen cylinders towed behind on a trailer. There is a crew of ten to each balloon and London is to have ten squadrons of fifty balloons each. 1, Stabilizer; 2, Rudder bag; 3, Air scoops; 4, Filling gland; 5, Handling guys; 6, Mooring cable; 7, Winch; 8, Hydrogen cylinders.



HOW A BOMB FALLS

DA is the dropping angle and LS the line of sight. FP is the flight path of bomb varying with speed of aircraft. VFP is the vacuum flight path or the path with no air resistance.



The "Field Sited" position of a balloon barrage over London. Five hundred balloons are employed. Their height is a secret.

ASHWELL
WOODY

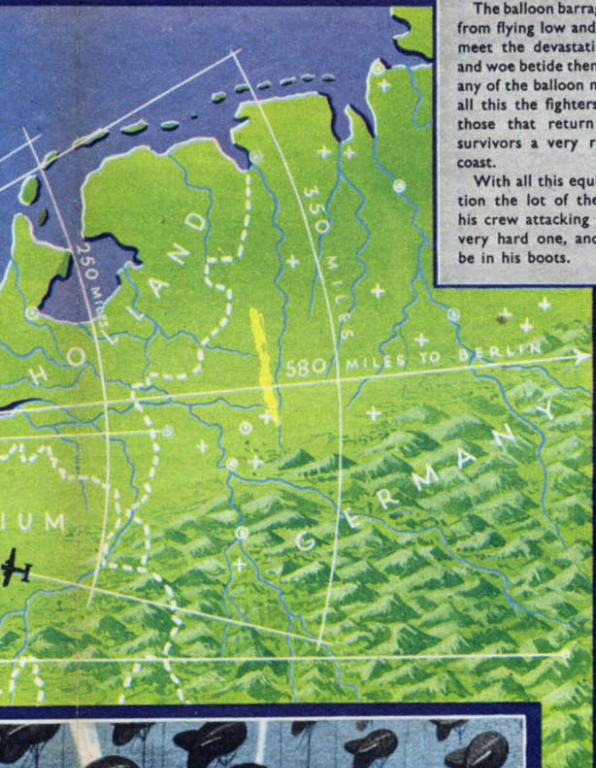
OF BRITAIN DEFENCES

INTERCEPTOR fighters will first take the air and hundreds of searchlights will come into action. Directly they have picked out a bomber the fighters will attack. These fighters are the fastest in the world and armed with many machine guns.

After the fighters have "laid off" for a while the anti-aircraft guns take a turn. These are wonderful weapons and fifty of them can concentrate their fire from any angle of approach to London.

The balloon barrage will prevent planes from flying low and so force them up to meet the devastating fire of the guns, and woe betide them if they should touch any of the balloon mooring wires. After all this the fighters will be waiting for those that return and will give the survivors a very rough passage to the coast.

With all this equipment and organization the lot of the bombing pilot and his crew attacking our shores will be a very hard one, and we should hate to be in his boots.



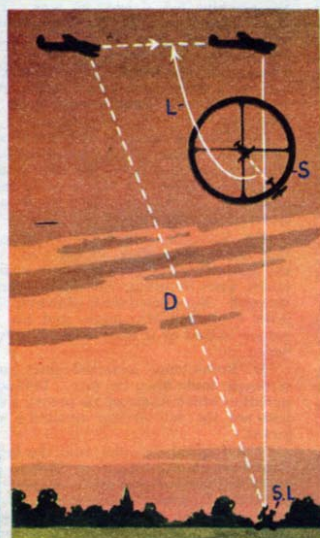
At a signal from the control officer the interceptor fighters take the air. The "Spitfire" fighters shown are the fastest in the world with a speed of 362 m.p.h.; they can climb to 11,000 ft. in 4½ minutes, and can cruise about for 3½ hours. Squadrons of these machines are placed all round London and to be attacked by something doing 360 miles an hour is not very pleasant.



3.7 ANTI-AIRCRAFT GUN
A very remarkable gun—can fire a shell to 40,000 ft. with a bursting range of 100 yds. Used with predictor (inset) which estimates where the plane will be when shell bursts. 1, Barrel; 2, Recoil chamber; 3, Quick-firing breech; 4, Elevating trunnion; 5, Elevating rack; 6, Cable from predictor; 7, Elevating gears; 8, Elevating balance springs; 9, Elevating control; 10, Telescopic sights; 11, Wheels; 12, Undercarriage.



This is what a balloon barrage would look like to a pilot flying at 15,000 ft. over London.



"Sound lag" due to aeroplane moving while sound is travelling to sound locator. D is distance between aircraft and sound locator SL. Position of aircraft is shown on ring of sight S, and the sound lag is represented by L.



SEARCHLIGHT DETACHMENT AT WORK

This consists of ten men: two on lorry, three on searchlight, three on sound locator, and two spotters. A, Petrol-electric generating lorry; B, Supply cable to searchlight; C, 90-cm. searchlight; D, Telephone cable from sound locator; E, Latest Mark VIII sound locator; F, Machine gun for low-flying aircraft.

TWOPENCE

Vol. 3, No. 53, Week ending May 25, 1938

EVERY WEDNESDAY

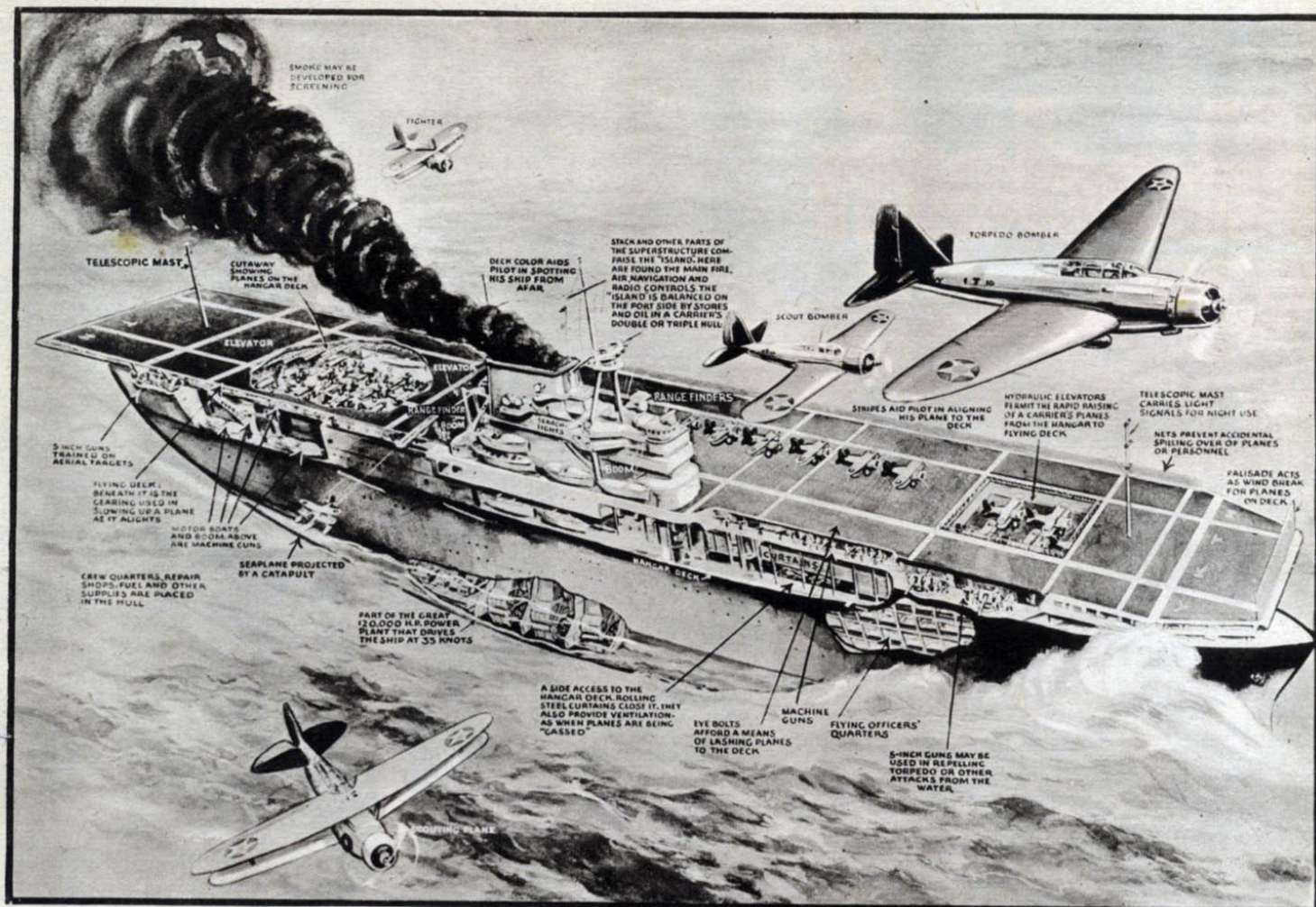
Modern Wonder



FIGHTING AIR RAIDERS

An anti-aircraft gun crew going into action with one of the new Bofors guns. With a vertical accuracy up to 30,000 feet, this amazing gun which is capable of firing a shell over Mount Everest, is described in the article on page 3 of this issue.

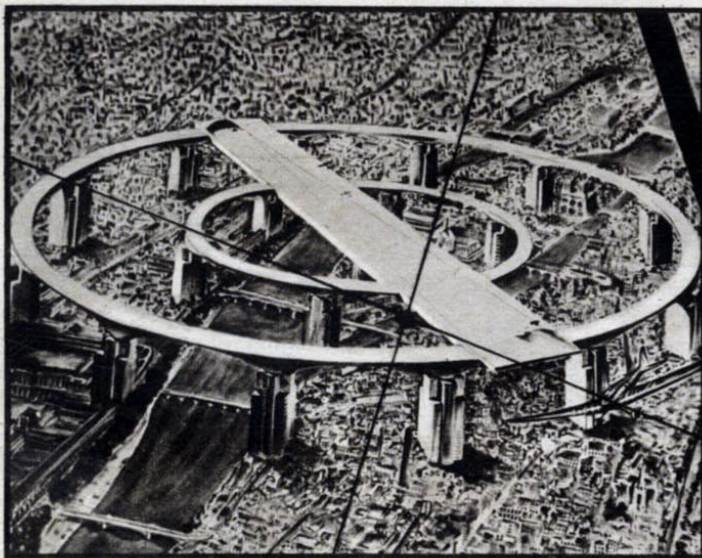
Amazing
**HIGH SPEED HYDROPLANE
PRESENTATION**
TO EVERY READER
See centre pages



U.S. NAVY BUILDS NEW MONSTER AIRCRAFT CARRIER

BUILT for the U.S. Navy the U.S.S. Yorktown is the largest and newest of America's aircraft carriers. Weighing 23,661 tons, she can carry 142 planes, nearly twice the load of the old carriers. The Yorktown is one of the most efficiently equipped aircraft carriers on the sea to-day; she cost £4,000,000 to build and carries a crew of 2,072; her sister ship is already nearly completed.

TURNTABLE DROME IN PARIS



This unusual landing ground for planes over the heart of Paris is the design of a well-known French engineer, M. Basdevant. Two circular lines of high towers support a vast frame across which is placed a runway wide enough to take several planes abreast. This runway would revolve on its own axis in such a manner that it faced directly into the wind to ensure machines taking off and landing safely. At present this aerodrome exists only in imagination—but dreams have a habit of coming true.

GAS FROM THE SUN



(Left) Otto H. Mohr, a Californian, with the machine he has invented to utilize the sun's rays in producing gas. Water is placed in a tank standing in the sun till it vaporizes, when it is passed into an acid-filled chamber that renders the vapour more conductive. An electric current then separates it into hydrogen and oxygen which are stored in tanks for cooking and heating purposes. (Right) Visitors inspecting a new mechanical model of the Port of London Docks at the P.L.A. headquarters in Trinity Square in the City of London.

VISIT TO DOCKLAND



The Miles "X2"—a new wonder plane

By **SELBY LEWIS**
Our Special Air Correspondent

(Above) The Miles "X2" will look like this — beautifully streamlined and speedy. Looking down on the "X2," it can be seen how enormous the wings are.



FLYING WINGS

AIRCRAFT designer Frederick George Miles, our brightest aviation star, has planned an air liner that should put Britain far ahead of every nation in the world as far as commercial air transport goes.

It is called the Miles "X2" and Miles himself has released some of the details of it for the readers of MODERN WONDER.

The machine is a flying wing. Although it faintly resembles the aeroplanes of today its entire fuselage is built on a wing section, so that none of it is a dead load—as are the fuselages of present day aircraft.

One direct result of this is that the wings have a shorter span than usual. These wings are extra thick at the roots, so that engineers can walk through them to attend to the four motors—of a new air-cooled type shortly to be revealed by a famous British firm. They develop over one thousand horse-power each.

All-up weight of the machine, including everything, is sixty-one thousand one hundred and twenty-eight pounds. It has a wing area of one thousand seven hundred and sixty-two square feet—but a wing span of only ninety-nine feet.

The loading of this wing is thirty-five lbs. per square foot. The overall length of the "X2" is 78.8 feet, and the maximum cross section of the aircraft is one hundred and fifteen square feet. This is the size of the area at the fattest part.

As a high-speed transatlantic liner, carrying eighteen passengers and a crew of four to five, it would have a non-stop range of three thousand three hundred and sixty miles against a continuous head wind of forty miles an hour—which you might have to expect over the Atlantic. This distance is ample for a London to

New York or Montreal run, and allows for a fuel reserve in case of emergency. Without this head wind the range would be four thousand three hundred and fifty miles.

The top speed is more than three hundred miles an hour. Cruising at two hundred and twenty-seven miles per hour at eleven thousand feet, it would have a range of three thousand five hundred miles and a range of three thousand six hundred and eighty at twenty thousand feet.

For the shorter European trips thirty-eight passengers can be carried, on a fuel load of seven hundred gallons, more than sufficient for London to Paris and back.

For the long European routes and various Empire routes thirty-two passengers could be carried, with a range of more than one thousand two hundred miles non-stop.

Landing speed with the loading of an Atlantic ship would be seventy-five miles an hour, and with a lighter loading sixty-five miles an hour.

This is with the Miles type of split flap, of course. And these landing speeds are not high. The machine would never need special great area landing fields. Its take-off run is not much more than four hundred yards—and with one engine out of commission it can still take off and climb in about five hundred yards.

Its climbing speed is one thousand five hundred and forty feet per minute with a "European" load and one thousand and forty feet per minute with the "Atlantic."

There are two absolutely new features about the machine.

One is that the engines are right inside the wings. The streamlined bulges that look like engines are not—they are only the casings of the long propeller shafts. These shafts are five feet long and have been tested now for many months, giving perfect satisfaction.

The great advantage of having the motors in the wings—apart from the fact that it gives better streamlining and therefore greater speed—is that engineers can get at them while the aeroplane is flying, so that if anything goes wrong it can be attended to during flight.

Secondly—the wings are built on a boundary-layer suction principle. You probably won't know what this means. Few people do.

The boundary layer is the layer of air right next to the wings and fuselage. It is little more than half an inch thick—but it can take up to forty per cent of the speed from an aeroplane's performance.

This is because the air in this boundary layer is inclined to turbulence. That is, it forms into little eddies and whirlpools, just like the water round the piers of a bridge in a fast flowing river.

Now, if this boundary layer can be removed, so that the air flows smoothly over the wings, there is an increased speed.

This is what Miles has done. Little holes in the upper surface of the wings

lead to ducts and pipes which in turn connect with suction pumps. These are driven by the engine and actually suck the boundary layer in through the wing and expel it from the trailing edge of the wings—adding several miles an hour of extra speed for little increased load.

At Reading Aerodrome, Miles has actually built an aeroplane—now flying—to find out everything about this new principle.

You will notice in the drawings of the cabin interior that the windows face downwards. This is the type of window you find in the promenade decks of airships.

Airline operators say that it is the ideal arrangement for windows in a passenger craft because the traveller can see out—and down—without leaning against the window or craning his neck.

The shape of the fuselage, allowing this unique window arrangement, comes from the flat oval form of construction employed, with the lifting fuselage and thick, wide wings, whose fillets, giving lift, travel right down as far as the tail.

The Miles "X2" is to be of all metal construction with flush riveting on all parts exposed to the airflow. Wing structure is on the stressed skin principle. This arrangement gives a lighter structure than the usual spar type of wing.

In the fuselage, monocoque construction is employed. This means there are no spars or bulkheads inside, giving greater room for the passengers and freedom of movement.

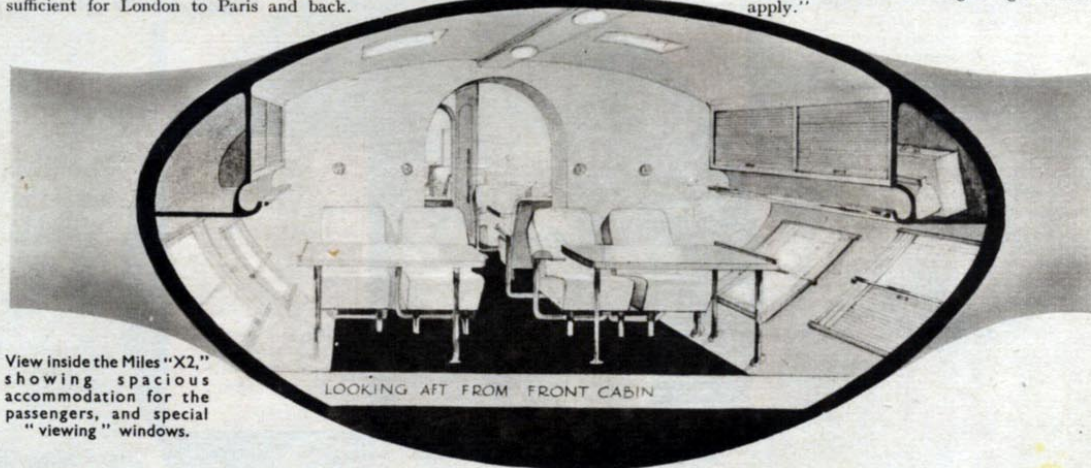
The undercarriage is fully retractable, and has three wheels, one in the nose, making for easy landings and controllability on the ground.

Mr. Miles himself says: "It is claimed that British transport aircraft are not up to the standard set in other parts of the world and efforts should be made to put British design ahead as soon as possible."

"I submit that efforts to do so will fail if we allow circumstances to force us into starting designs on either too orthodox or too unorthodox lines. Either of these alternatives may be adopted by the designer goaded into action by the critic of today."

"The Miles 'X' is a striking advance in general arrangement—but its design does not bring in fresh problems of control and stability. As far as the relative positions and areas of lifting and control surfaces are concerned all existing design criteria apply."

View inside the Miles "X2," showing spacious accommodation for the passengers, and special "viewing" windows.



A very strange looking craft seen from this angle.

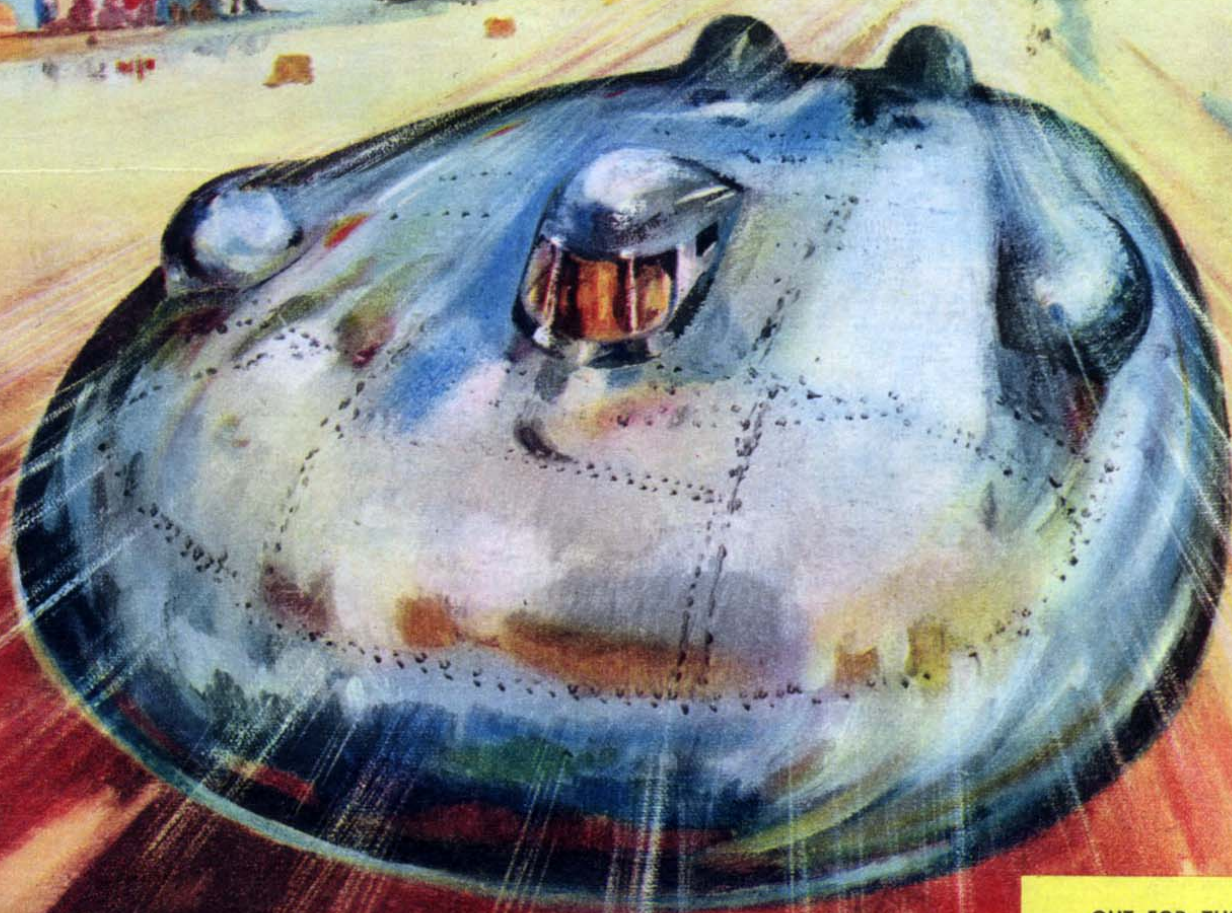


EVERY WEDNESDAY

Vol. 2 No. 52 Week ending May 14, 1938

TWOPENCE

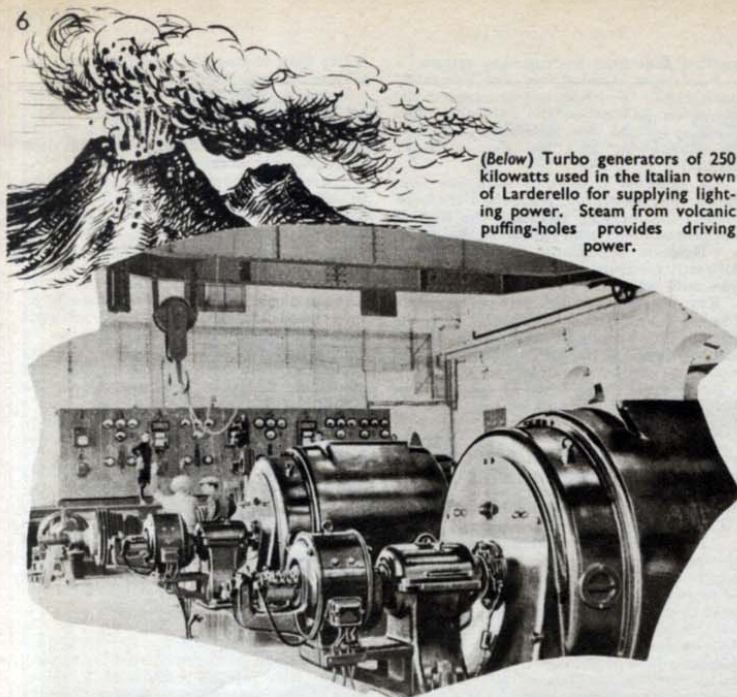
Modern Wonder



OUT FOR THE RECORD

THIS is John Cobb's new record-breaking car. Like many famous British record breakers, the car has been designed by Reid Railton, but it differs from cars of the past, being light, low-powered and small as compared with Eyston's *Thunderbolt*. Cobb expects to beat the land speed record of 312 m.p.h. set up by Eyston last November, with a speed of 350 m.p.h. The driver sits in a conning tower right at the front of the car with the two Napier aero-engines developing 2,500 h.p., in staggered positions behind him. One of the engines drives the front wheels and the other drives the rear wheels which are of smaller track than those at the front. You will find more pictures and details of the car on pages 6 and 7 of this issue.

IN THIS ISSUE: THE INVISIBLE LIGHT •
VOLCANOES PROVIDE POWER • NEW WONDER
DESTROYERS • WORLD'S STREAMLINE TRAINS



(Below) Turbo generators of 250 kilowatts used in the Italian town of Larderello for supplying lighting power. Steam from volcanic puffing-holes provides driving power.

THEY GET their POWER from VOLCANOES

IN Italy there are steam engines that have never been stoked by man or machine, and have been running for thirty years. They have no boilers—just a cylinder and a flywheel.

There are whole towns lit and powered with electricity generated without fuel; a whole countryside energized practically free of cost. Nature provides the motive power: live steam, ready to run an engine or a dynamo without any other trouble than taking it out of the ground.

Italy is unlucky about coal; she has practically none of it. But about volcanoes she is luckier—if that is the word. At all events, volcanoes aren't always disastrous, and to the Italians be the credit of first making volcanoes work for man.

Speaking literally, the country is really one big volcano. Italy and its surrounding seas float on a part of the earth's rind where the inner fires seethe nearest the surface. Blow-holes in that thin crust are Vesuvius, Etna, on the island of Sicily, and Stromboli, on another island to the north of it.

Elsewhere, minor safety-valves abound, as in the Lipari Islands, also just north of Sicily. The really useful one is in the region of Florence and Siena.

Run your eyes up the shin of Italy's "boot" on the map. Towards the top, opposite the island of Corsica, is Tuscany, where there is a region that the ancients believed to be the roof of hell. For centuries it was uninhabited. From holes in the ground everywhere spurts steam. There are many ponds of boiling water.

Or, rather, there were in the past. The steam does not drift away, wasted, nowadays. The once desolated and deserted region is dotted with villages and towns. And the steam is working for their inhabitants.

Curiously, the water and not the steam was first found to be valuable. It contained borax, which at that time—over a hundred years ago—was a rare commodity found only in one or two places on earth.

The local people filled large pans with the volcano-boiled water, lit wood-fires underneath, and boiled it completely away. The residue

of borax they sold to glass factories in France and elsewhere.

Just as happens in the oil-well country, somebody had the notion to drill holes in addition to the natural puffing-holes, as they are called. Soon the landscape thereabouts was punctured with hundreds of them, each yielding its quota of either boiling water or live steam, and not diminishing in the slightest the pressure from earlier ones.

The borax industry thrived to such an extent that in a few years all the available firewood was burned and it became more valuable in the district than the borax itself. Then came someone with the idea of using the earth-steam further to heat the water, and the industry made a fresh spurt.

This was Count Larderello, a Frenchman, after whom was named the town of Larderello which has grown up since as the result of his simple invention. The method, which is still continued, is to draw off the natural borax-water into large, shallow pans, which are heated from underneath by natural steam piped to the spot from the handiest puffing-hole.

For many years that was the only use made of this munificent gift on the part of nature. It was not till 1905 that engineers suggested coupling up the puffing-hole with a steam engine.

They said that as the steam was as much as three hundred and fifty-six degrees Fahrenheit in temperature, and one hole delivered anything from six to thirty thousand pounds pressure an hour—equal to the energy obtained from burning about a ton of coal—there should be no reason why an engine wouldn't work.

There wasn't. It did. It worked beautifully—and a new and even bigger industry was born.

Soon an earth-steam engine was hitched up to a dynamo and generating enough electricity to light the borax factory. Year in and year out it has been running since then, and not a penny in fuel has it cost.

To get more electricity was only a matter of fitting new generators, and within the time necessary to build and instal them and get them running, 250-kilowatts turbo-generators were



The man in the foreground is covering over one of the innumerable small blow holes that are constantly appearing in the vicinity of Volterra in Italy. Steam is often found at only sixty feet from the surface.



SIX MILES A MINUTE NEXT!

BIGGEST motor-race this season is the international race for that most important of all speed records—the land-speed record.

Britain has made this record her own—a Briton was the first to achieve one hundred and fifty miles per hour, the first to pass the magic two hundred miles per hour mark, and the first to reach three hundred miles per hour. Algeron Guinness, Parry Thomas, Segrave and Campbell have won for their country great prestige in the world of speed. Some died in those attempts.

Other countries have turned envious eyes towards this proud record.

This month Captain George Eyston, holder of the existing three hundred and twelve miles per hour record, leaves for the salt beds course in Utah, U.S.A. This desert of dead-smooth, hard-baked salt near the Mormon city is the only suitable course for modern high-speeds.

Eyston, with the same *Thunderbolt* which set the existing three hundred and twelve miles per hour record last

November but re-designed in many of its features will be the first in the field.

Then Brooklands champion, John Cobb, with his new and revolutionary record-breaker, will have a try. Another in the race is Ab Jenkins, the lone American record-breaker, with a car that is stated to be ready but of which no details have been issued.

Fourth contender is another "mystery" car—a German car designed by the famous Dr. Porsche who also designed the record-breaking German machine. The car is nearly ready, but its construction was interrupted by the death of champion Bernd Rosemeyer, who was killed when he crashed on the Frankfurt-Darmstadt autobahn in an experimental record-breaker at two hundred and sixty miles per hour.

Germany cannot so far find another driver to replace Rosemeyer, who had risen from the ranks of the racing mechanics to all-conquering brilliance, but work on the car which will have two engines, six wheels and weigh under two tons, is now proceeding.

Germany, to add to the advertisement of her engineering skill that the victorious racing-cars have brought her, would dearly like to gain the world land-speed record.

It is planned to try out the German car on the autobahns first and then, if necessary, send it to Utah.

And our own record-breakers?

First there is *Thunderbolt*, designed by her owner and driver, George Eyston, our most successful record-breaker and the man with the most experience.

His enormous car—it is thirty-six feet long and weighs seven and a half tons—is powered by two Schneider Trophy-type, twelve-cylinder supercharged Rolls-Royce engines. Nobody knows what horse-power these engines develop—one engine, was in the Derby experimental works, "boosted" to a "flash-reading" of three thousand brake-horse-power.

Eyston keeps silent about the horse-power he has available—it is certainly four thousand horse-power and maybe six thousand.

The two power-units are set side by side amidships in the chassis and drive, through separate clutches, to an enormous three-speed gearbox that weighs a ton, which in turn, through a short and massive shaft, drives the rear axle.

Originally the car was designed to have two rear axles, one behind the other, the engine drive being taken to all four rear wheels. For his attempt last year, Eyston dispensed with the rear-most axle, and fitted twin-tyred wheels to the one.

Eyston tells me he is yet undecided what he will do on his next attempt. Four separate wheels will give him greater adhesion and so lessen wheelspin and the strain on the clutches—trouble from which he suffered last year.

Because of the tremendous weight of the car—*Thunderbolt* is the biggest and heaviest car ever built—it has four wheels in front, all of them steered. Rather on the lines of an eight-wheeled lorry the four front wheels can be turned by the driver.

Eyston sits in a tiny cockpit, enclosed

feeding cables that carried power to Volterra, thirty miles away.

As a city, Rome is fairly old, but Volterra had the start of it by several centuries. It is curious that this very ancient place was the first in the world to draw its electricity from under the earth.

On the map of Tuscany you will find the names of Piombino and Leghorn on the coast, and Siena and Florence fifty miles inland. In that widespread area are dozens of smaller towns and villages which, like them, are fed from the earth's exhaustless reservoir in the molten volcanic depths.

The reason for the steam's presence is, of course, no mystery. On to the layers of hot or molten rock oozes down water from the land or the sea-bed above. Straightway it is turned to steam. The pressure grows. The steam thrusts upwards, seeking a way of escape.

Nature has provided that way in the innumerable blow-holes in the ground; or, when the pressure becomes exceptionally severe, in an eruption from one of the volcanoes. But there is a supply of steam, ever renewed by the continuous seepage, that never fails, no matter how many additional holes are bored by man. The pressure remains constant over the area.

Getting steam for your engine in the Larderello regions is a simple matter. A hole is drilled, much like that of an oil-well, but for only a fraction of the distance. It is seldom necessary to go deeper than four hundred feet, and often live steam is found at sixty feet. As the hole is bored, it is lined with an iron pipe about a foot in diameter.

At the first sign of steam the drill is removed and a heavy weight, just fitting the pipe, is lowered. From the bottom it is yanked suddenly upward by an electric winch. The pent-up steam, rushing to fill the partial vacuum created, bursts out.

Boiling mud and stones shoot forth in a shower. For some minutes this miniature eruption goes on, and then, when the hole has cleared itself, the steam alone is left, hissing with a deep and almost terrifying note.

From that point to the burning of electric lamps, the turning of lathes, the working of radio sets and vacuum cleaners and lifts in places fifty miles away is a matter for the engineers.

Mankind has harnessed the earth's internal fires.

(Left) The glass-panelled conning tower of John Cobb's Railton car in which he is to attack the world's land speed record.

T. H. WISDOM, the Motor-ing Editor, tells you of the mighty cars and drivers bent on raising the land-speed record

except for a space over his head, ahead of the engines. On either side of him are enormous disc-brakes connected by short shafts to the rear set of front wheels.

It's an awesome affair this "engine-room" in *Thunderbolt*. Eyston asked me to climb into the seat to see how the brakes worked—it took me five minutes to get in and as long to get out, so cramped is the seat in this biggest of all cars.

Eyston, who has kept his car from prying eyes in a workshop near Wolverhampton that is on the Air Ministry secret list, has concentrated on the design of a new and better streamlined body. It is even longer than the old one, and has a bigger "fin."

And the speed he is aiming at? Eyston refused to be drawn on this subject. He says that he hopes to average three hundred and twenty miles per hour—last year he made that average on one run, the mean speed of the two runs across the kilometre (necessary for a record to rank officially) working out at exactly three hundred and twelve miles per hour.

I expect him to do three hundred and thirty miles per hour, and maybe three hundred and forty.

Eyston himself is a slow speaker, a quick thinker. He doesn't look like the

typical idea of a "speed-king," with his horn-rimmed spectacles and City clothes. But on a record run, and it has been my pleasure to drive with him on a number of long-distance attempts at Montlhery, the French Brooklands, he's a different man.

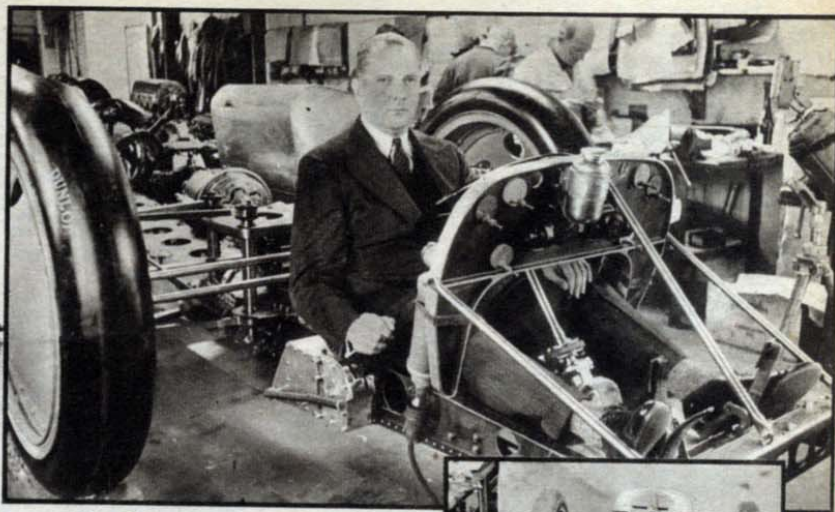
Forty-three years of age, he keeps himself very fit (he walks and rows, drinks and smokes very little, drives a two-seater three and a half-litre Bentley on the road) and is worshipped by his band of mechanics. He's a "great guy."

His friend and rival, John Cobb, has the smaller car, but is the bigger driver. "Honest John of Brooklands"—he's the champion track driver and holds the 143.44 m.p.h. lap-record—has driven at a hundred and eighty miles per hour (at Utah on long-distance records). Now he plans to drive at nearly twice that speed.

He is a fur-broker by profession, unmarried and thirty-seven years of age. He says he has great trouble in "getting leave" from the office to race.

The Railton has been designed from the first stages by Reid Railton, famous automobile designer and founder of the firm which builds Railton touring cars.

He was responsible for the design of all Sir Malcolm Campbell's recent record-breaking *Blue Birds*, but with this new car he started with nothing but the power-units—two supercharged



John Cobb seen at the controls of his car. The streamlined body is detachable and can be lifted off the chassis in a matter of minutes.

twelve-cylinder Napier aero-engines developing, together, two thousand five hundred horse-power.

Railton designed the body first—something between a tear-drop and a flattened-out pear. He put his driver right in the front, with a conning tower from which to view the course. As John remarked: "Well, I'm certainly close to the accident!"

Railton thinks many existing ideas on record-breakers are wrong. For instance, he says that tail-fins, which have been fitted to nearly all recent record-breakers, are unnecessary. His opinion is that "a fin is useless unless the car skids badly and then its value is problematic."

Experts, when they first viewed the Railton, and bearing in mind Rosemeyer's fatal crash, said, "It's fine—if it stays on the ground." The designer replied: "In view of the false ideas which are current about accidents to record-breaking cars this question as to whether the car will lift at high speed is bound to be asked. The answer is that the shape of the body is such that any lifting effect is negligible."

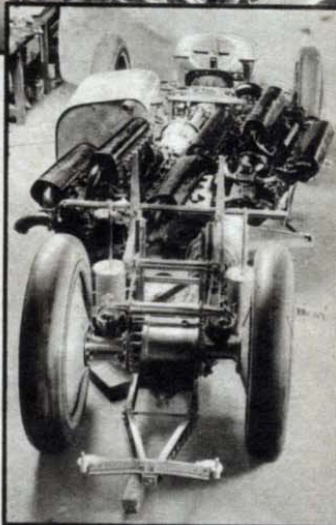
This is what the Railton is like: It has for chassis a single and massive girder, shaped rather like a flattened-out S—a "snake's back-bone," somebody called it. The engines are staggered, rear engine driving at an angle the front wheels, and front engine driving rear wheels.

The front wheels are independently sprung and have a track of five feet six inches; the rear wheels are connected by a "solid" axle and have a track of three feet six inches. The car is, accordingly, crab-tracked.

The length of the car is twenty-eight feet eight inches; it is four feet three inches high and eight feet wide.

I think that Railton and Cobb are aiming at three hundred and fifty miles per hour. Neither will be drawn on this question of ultimate speed, but Reid Railton did say to me: "It is only possible to say that the car has been designed to go faster than any car hitherto used for the land-speed record, or any car which will be in existence this year."

So there you have the complete story



The chassis of the Railton car showing the crab-tracked axles, the front axle being 5 ft. 6 in. and the rear 3 ft. 6 in. in track

of the drivers and cars for this season's great race for the land-speed record:

George Eyston, with lots of experience and a car that we know is capable of three hundred and twenty miles per hour;

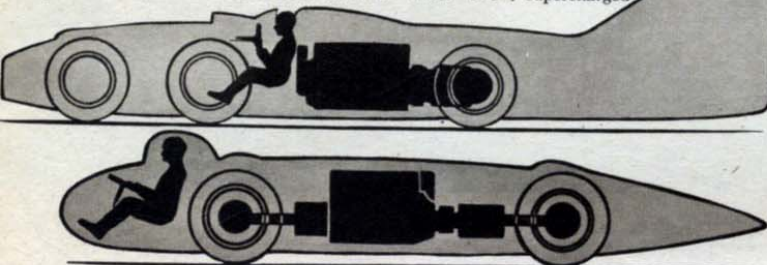
John Cobb, with less experience and a car that, on paper, is capable of three hundred and fifty miles per hour;

The yet-to-be-chosen German and a car that has been designed to break the record, but has tragedy behind it;

Ab Jenkins and his American-built machine, the real mystery car of the whole lot.

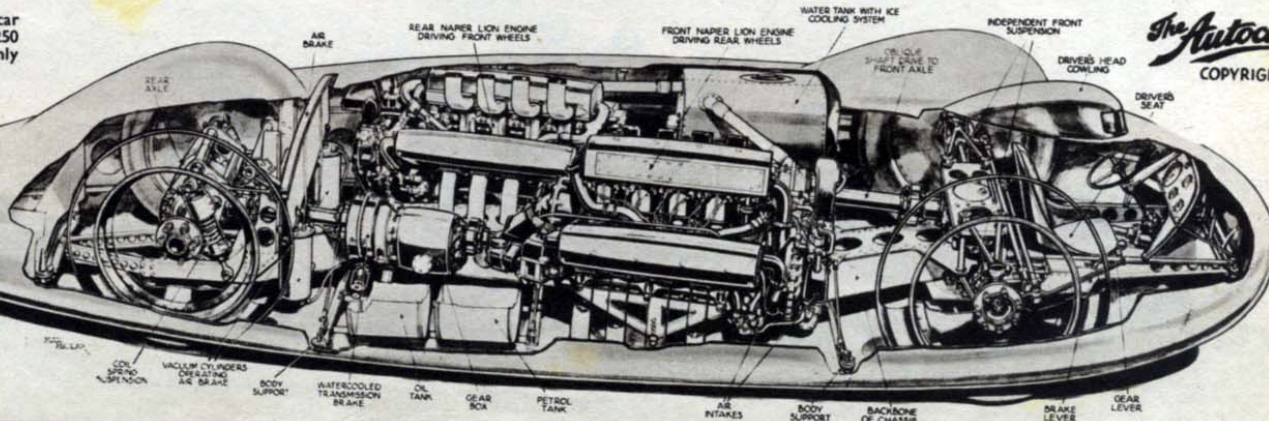
I still think that 1938 will go out with the most important of all speed records in British hands. I'm backing George and John—which of them will be successful I cannot decide.

Both will be taking colossal risks—this business of travelling at six miles a minute on land is a "death or glory" affair—but they say to me, "Oh no, it's not dangerous—with a properly designed car it's 'safety first' every time."



Studies in contrast: The upper silhouette shows the position of the engine and driver in Capt. George Eyston's record-breaking *Thunderbolt*, and the lower shows how they are arranged in John Cobb's revolutionary new car.

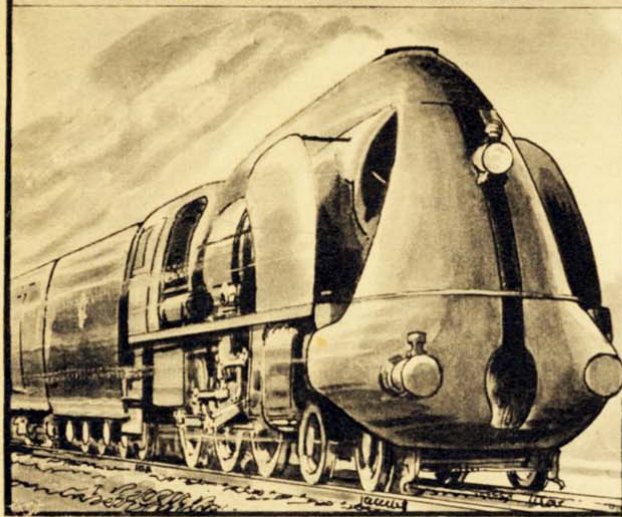
A sectional view of the car which, with its two 1,250 h.p. engines, weighs only three tons.



The Autocar
COPYRIGHT

NEW MONSTERS OF THE IRON ROADS

This curious looking job is a 4-6-0 of the French State Railways, modernized by the Huet system of streamlining, which has the advantage of giving free access to all the working parts. The casing consists of deflectors that have the effect of setting up layers of air all round the engine, checking the formation of the eddies that cause the wind resistance.



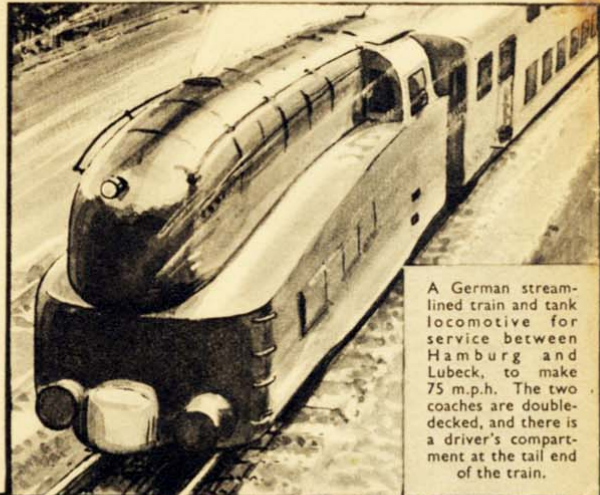
STREAMLINING has come to stay in the world of the railway engineer. That it has proved its worth can be taken for granted, and you can rely on it that in a year or so we shall see only streamlined locomotives built.

Why is this? Not just for speed, though that is useful, but for the sake of the economies in power that can be effected.

Speed is expensive, and to cut an hour off the running time for 400 miles costs an extra ton of coal and about 10 tons of water.

But streamlined locomotives cut a ton off the coal bill, and so the cost is no greater, but we have a faster train, the sort that people will gladly pay extra fares to travel in.

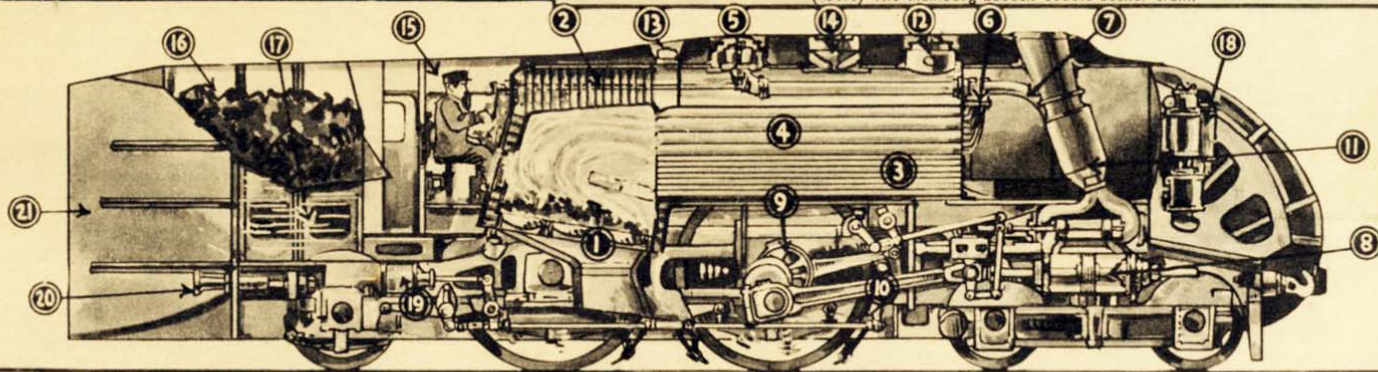
A normal locomotive of about 1,800 h.p. may lose 120 h.p. through wind resistance at 60 m.p.h., 275 h.p. at 80 m.p.h., and as much as 530 h.p. at 100 m.p.h. The streamlined locomotive loses practically nothing.



A German streamlined train and tank locomotive for service between Hamburg and Lubeck, to make 75 m.p.h. The two coaches are double-decked, and there is a driver's compartment at the tail end of the train.



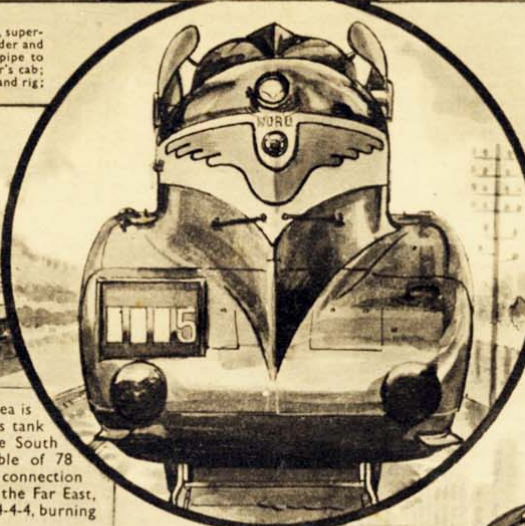
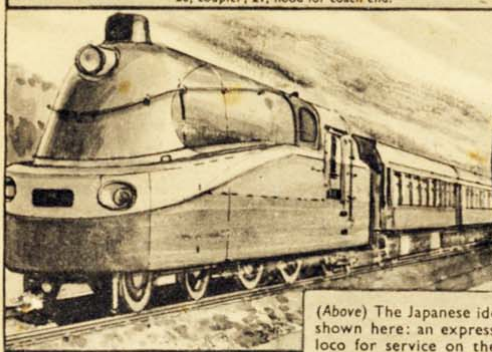
(Above) The Hamburg-Lubeck double-decker train.



KEY TO SECTIONAL VIEW OF GERMAN LOCO.

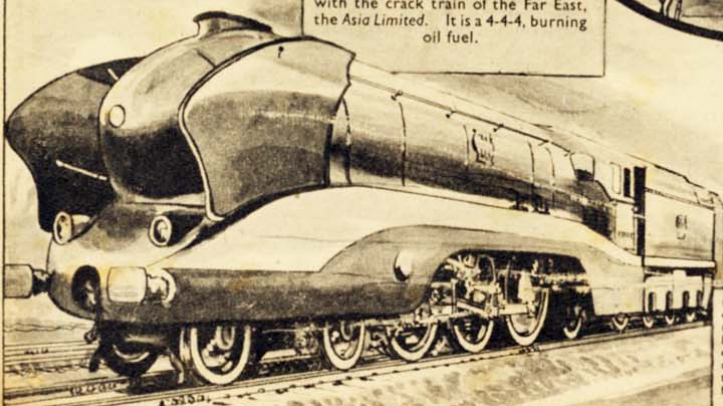
1, Grate and firebox; 2, boiler, pressure 300 lbs. per sq. in.; 3, boiler tubes; 4, superheater flues; 5, throttle valve; 6, superheater header; 7, steam pipe; 8, cylinder and valve chest; 9, eccentric and valve motion; 10, connecting rod; 11, blast pipe to chimney; 12, water feed to boiler; 13, safety valve; 14, sand box; 15, driver's cab; 16, coal bunker; 17, water tank; 18, air pump for brakes; 19, brake cylinder and rig; 20, coupler; 21, hood for coach end.

(Left) One of the famous "Super-Pacifics" of the French Nord, enclosed in a new streamlined casing. This has a system of deflector plates instead of glass to the engineers' look-outs. No rain or cinders can blow in, though there is nothing to obstruct vision.

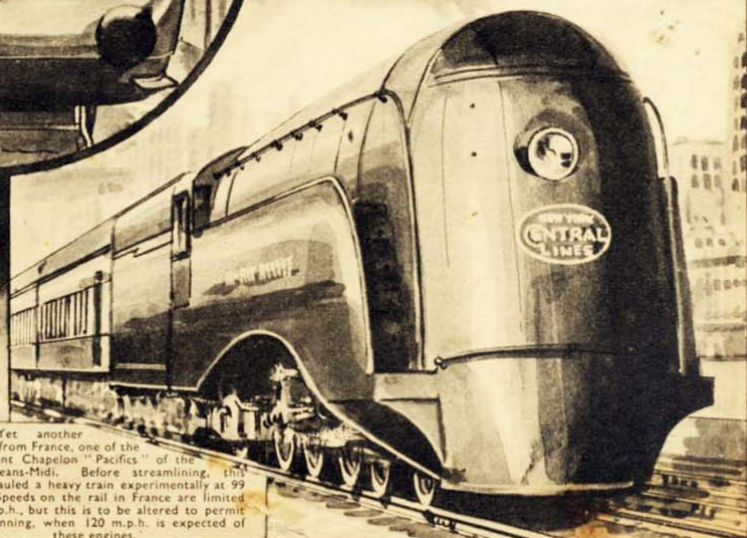


(Above) The Japanese idea is shown here: an express tank loco for service on the South Manchurian line, capable of 78 m.p.h. This runs in connection with the crack train of the Far East, the Asia Limited. It is a 4-4-4, burning oil fuel.

(Below) There is no end to streamlining in America, and here is one of their designs. Commodore Vanderbilt is a huge 4-6-2, built to haul the crack 20th Century Limited between New York and Chicago. To cut the time, more power was needed, so they gained this by saving what had been wasted in wind resistance before.



(Left) Yet another example from France, one of the magnificent Chapelon "Pacifics" of the Paris-Orleans-Midi. Before streamlining, this engine hauled a heavy train experimentally at 99 m.p.h. Speeds on the rail in France are limited to 80 m.p.h., but this is to be altered to permit faster running, when 120 m.p.h. is expected of these engines.



ZIPPER!

THE MODERN BUTTON

YOU'VE probably heard that joke about the zipper: a hospital patient had to have so many operations one after the other that the surgeon got tired of taking out and putting in stitches each time, and fixed up the patient with a zipper instead.

The actuality occurred in a Chicago hospital in December, 1935. A man suffering from a growth in his stomach had to have it cauterized at intervals lasting over weeks. During all this time it was necessary either to keep the wound open, or to reopen it on each occasion.

The surgeons solved the problem by sewing the edges of the opened stomach to the corresponding edges of the slit in the abdomen. Then, with adhesive tape, they fastened a zipper to the slit, thus preventing the wound from healing before its time, and allowing easy access for cauterisation as often as required.

factory is an eye-opener. In one corner of a room you may well see a pile of mighty springs weighing over three hundredweight apiece. Two feet tall, and made up of six massive coils.

What are they for? Probably some big liner, or warship—to be bounced about under a pressure of twenty or thirty tons!

In the same factory, a few rooms away, will be dozens of trays, heaped high with tiny springs of brass, steel, and bronze. They will be for dynamos, cigarette lighters, spring-hinges, vacuum cleaners, locks, and almost anything else you can think of.

There are two ways of making a spring. Cold and hot. Most of the smaller springs are made "cold." That is to say the springy wire is guided by hand onto a revolving spindle, and cut after the right number of turns.

After they leave the spindles the springs are tested, squeezed or stretched to the right length, and, if necessary, plated with chrome, nickel, or silver, or even painted. It all depends what they have to do.

The larger springs are made "hot." First the metal is chosen, according to the type and strength of the spring required. Then it is cut into rods of the correct length and placed in a furnace—rolled up if it is too long to go in straight.

When red hot, it is pulled out like a huge piece of soft barley sugar, and one end is slipped under a clip on a drum. The workman moves a lever, and the drum revolves. The plowing metal coils round it like a red hot snake.

By H. W.
Twyman

That use for a zipper is probably unique—but it is only one of many.

Within the last three or four years the slide-fastener device has become familiar to almost every person in every civilized country. Zip! The thing is fastened—unfastened. Its ingenuity, its world-wide acceptance and usefulness, give it rank as one of the minor wonders of the modern world.

Yet it is still a bit of a mystery. Who invented it? How does it work?

The name of the man who first thought of the idea of putting a button on one piece of cloth and a hole in the opposite piece is lost in the mists of antiquity.

Doubtless that was just a big advance in its day, but mankind has had to wait for centuries for the next, the zipp-fastener. And incidentally we had to wait twenty years before we could begin to get the benefit of the original invention.

The genius whom we have to thank for the zipper is W. L. Judson, of Chicago. The world's first specimen of its kind was made by him in 1893.

Compared with the precision products of today, it was cumbersome and uncertain in its working; but the idea was there—the basic principle which has functioned in a myriad zippers since. Judson, in fact, was never able properly to perfect the thing.

A lawyer named Colonel Lewis Walker saw it, however, and despite its embryonic state immediately realized the possibilities of this supplanter of buttons and hooks and eyes, and acquired the rights in it.

He had to spend a million dollars and wait twenty years before success came to reward his faith. The money was mainly spent on

In that state it is a spring without any spring in it. When it cools down it is just a lifeless coil of metal.

After undergoing several intermediate treatments, upon which its future useful life will depend, it is placed in another furnace, till it passes red heat and reaches a definite temperature.

A critical moment it is whisked from the furnace on to a metal trough—manipulated by immense pliers to its proper length—and plunged into a tank of oil. Bubbles and vapour and strange rumblings come from the tank as the spring is born.

When it is pulled out, cool and bluey-grey, it is no longer lifeless—but tough and resilient. A spring! It may be for a railway buffer, a steam roller, or a pneumatic drill.

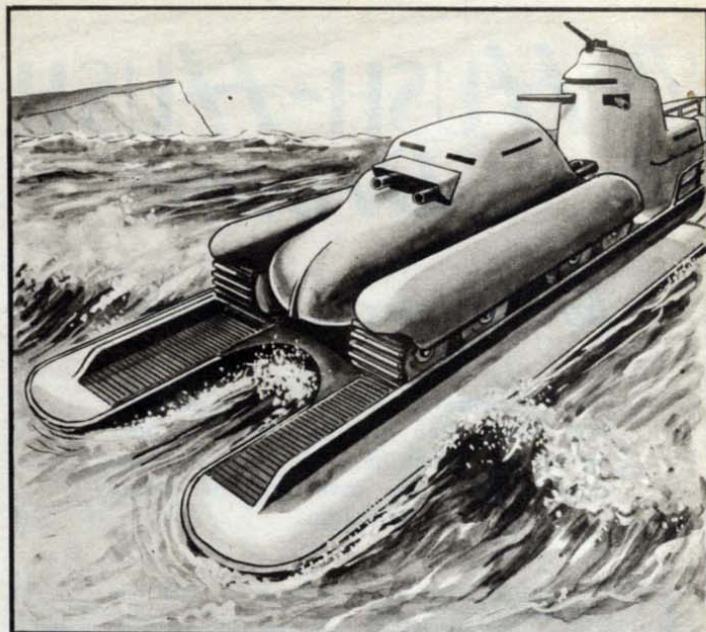
From the time we get up in the morning—woken by the tireless springs of the alarm clock—until we sink back on to our bed of springs at night, we live by, with, and on springs. In all we use at least one thousand a day.

Traffic lights, lifts, weighing machines, clothes pegs, mangles, egg-beaters, and radios—all have springs. A bus has thousands—in the seats, over the wheels, in the tyre valves, on every valve in the engine, in the clutch, brakes, dynamo, magneto, door handle, and bonnet clip.

There is no end to them—thank goodness!

Yes, the world would be a hard and uninteresting place without springs!

So, hats off to springs!



TANK ATTACK!

A New War Amphibian

The craft pictured above is a new type of armoured speed boat designed to carry a light tank on her covered deck. Constructed at Portsmouth, Virginia, for the United States Navy, it is intended for use when troops have to be landed under heavy fire from shore defences.

Its curved double prow enables the craft to be driven right up to the shore and as soon as it touches, the tank which is already stationed in the bows, moves down the curved slope to engage at close quarters the enemy defending the shore.

The superstructure of this new type of craft closely resembles a monitor with its flat, heavily armoured deck and the steel-sheathed conning tower set far in the stem. The machine-guns mounted to port and starboard enable a heavy fire to be kept up when the craft is going astern after having landed the tank.

research, experiments, machines and tentative attempts at manufacture. But the zipper still waited the polish of perfection.

That arrived only when a certain Gideon Sundback was given the job of seeing what he could do about it. His cleverness made the zipper a smooth-running, reliable, perfect bit of mechanism.

In 1913 Colonel Walker got under way with regular manufacture. His first factory was a shack at Meadville, Pennsylvania, rented at only £60 a year. A few months ago his firm was estimated to be making about thirty-five million zippers a year, or about three-quarters of the United States output.

His original outlay of a million dollars, spread over twenty years, has been well repaid. Each year the firm makes about that much in clear profit. The shares, worth hundreds of times their face value, are in the hands of less than one hundred and fifty shareholders, and when an offer was made to buy them for 3,500 dollars each, nobody would sell.

Meantime, apart from being made by about twenty other American manufacturers, several other countries and dozens of other firms have come into the field. In fact, the zipper has achieved almost the status of international politics, for when Japan with its cheap labour began to flood the U.S. market President Roosevelt clapped a sixty-six per cent import duty on them.

However, to side-step politics and finance and return to the zipper itself, how does it work? Most people have puzzled over that question. Some may have worked out the answer; others are still mystified.

The slider hides the gadget's secret, closing or opening the little teeth out of sight. But the diagram will make it clear; it's really a matter of an exact angle. A close inspection of a zipper's teeth will show that each has a depression or hollow on the underside, and a corresponding bulge on the upper side.

This bulge is angular, and when the tooth is pushed between its two opposite teeth at the exact angle there is just enough space for it to enter. Straightening, its hollow and bulge

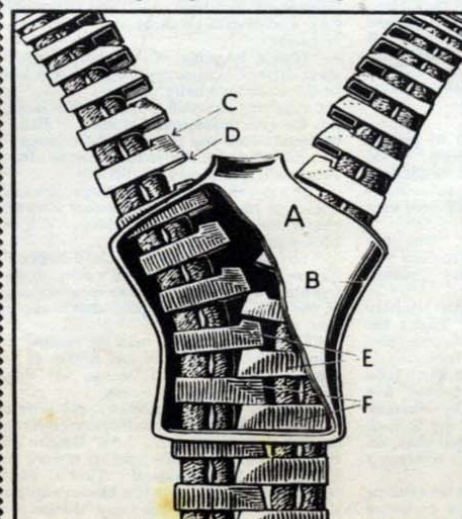
then engage with those of the other teeth, and the line of them so locked together cannot be pulled apart.

Most zippers are made in brass with either a gilt or nickel finish, but a recent development is the plastic variety in various colours to match women's dress materials. Also, to remove the zipper's obvious limitation that both sides could not be completely parted, the open-end idea was developed. This simple addition allows the modern, button-superseding fastener to appear on coats and jackets.

How many different articles are zippers used on? Scores—perhaps hundreds. We can think only of a few. Women probably find the most use for them, on all types of garments used throughout the day and the year; on handbags and cushion-covers and furniture covers; on luggage and hat-boxes, and boots.

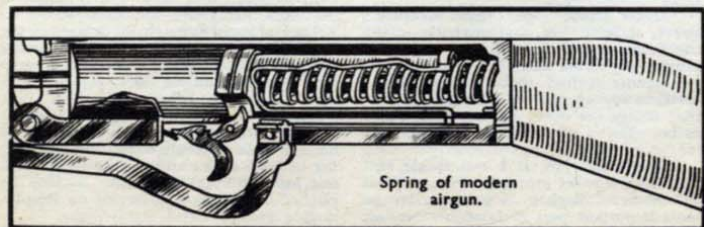
But men haven't ignored this little modern wonder, for all their conservatism in dress. Their golf-bags and tennis racket cases and overalls will indicate that—among other items. And one of the very first zipper-uses was for tobacco pouches.

Besides, wasn't it a man doctor in Chicago—the place of its invention—who used it to button up a patient?



KEY TO SECTIONAL DIAGRAM

- A. Slider
- B. Angle necessary for closing and opening
- C. Bulge on top of tooth
- D. Hollow under tooth
- E. Teeth partly engaged
- F. Teeth fully engaged



Spring of modern airgun.

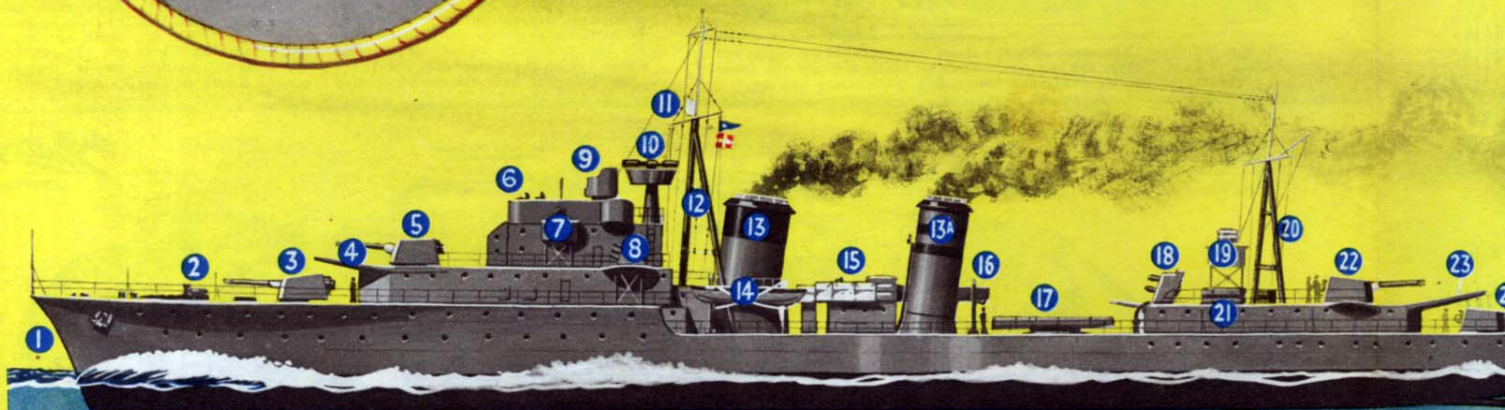
NEW

UNDER the
destroyers
For the first
design has been
"L" classes, de
They are of L,



KEY TO SINGLE-FUNNEL DESTROYER

- | | |
|---------------------------------|------------------------------------|
| 1. Jackstaff | 17. Multiple pom-poms |
| 2. Capstans | 18-18a. Torpedo loading cranes |
| 2a. Breakwater | 19-19a. Boiler rooms |
| 3. Forward twin 4.7-in. guns | 20. Quintuple 21-in. torpedo tubes |
| 4. No. 2. Twin 4.7-in. guns | 21. Searchlight |
| 5. Paravane | 22. Engine room |
| 6. Forecastle deck | 23. Quintuple 21-in. torpedo tubes |
| 7. Multiple machine guns | 24-24a. Depth charge throwers |
| 8. Signalling searchlight | 25-25a. Depth charges |
| 9. Carlew floats | 26. Carlew floats |
| 10. Upper bridge | 27. After twin 4.7-in. guns |
| 11. Fire control tower | 28-28a. Winches |
| 12. Twelve-foot range-finder | 29. Companion-way |
| 13. Tripod mast | 30. Capstan |
| 14. Single funnel | 31. Depth charge discharger |
| 15. Twenty-seven-foot whaler | 32. Ensign and staff |
| 15a. Twenty-seven-foot whaler | 33. Twin propellers |
| 16. Twenty-five-foot speed boat | |



New super-destroyer of the "Tribal" class. Largest in the navy. Water-line length of 364 feet. Sixteen are being supplied this year.

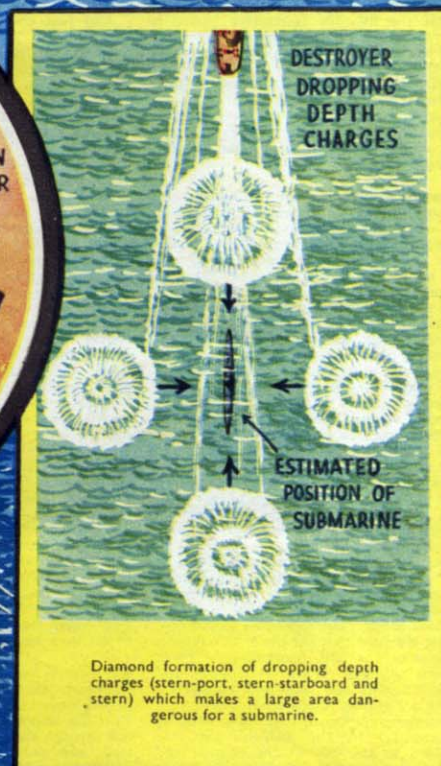
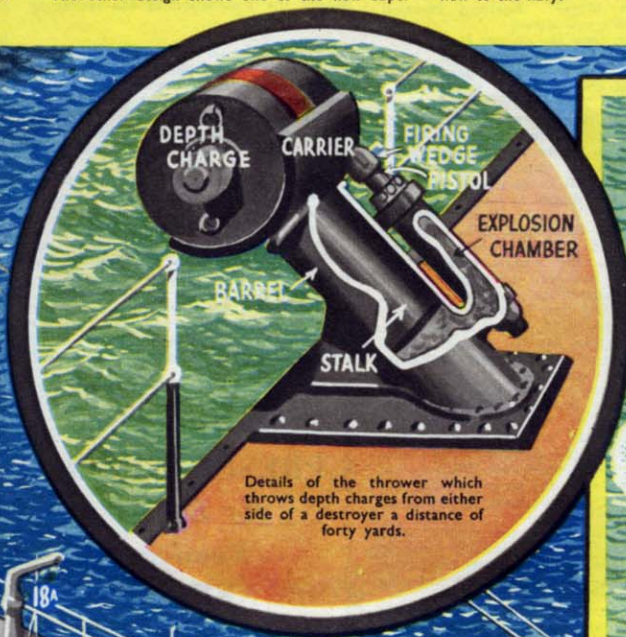
NEW WONDER DESTROYERS OF THE ROYAL NAVY

UNDER the new armament programme many destroyers will be added to the navy this year. For the first time in many years a single funnel design has been adapted for the new "J," "K" and "L" classes, details of which are shown below. They are of 1,690 tons displacement, and their

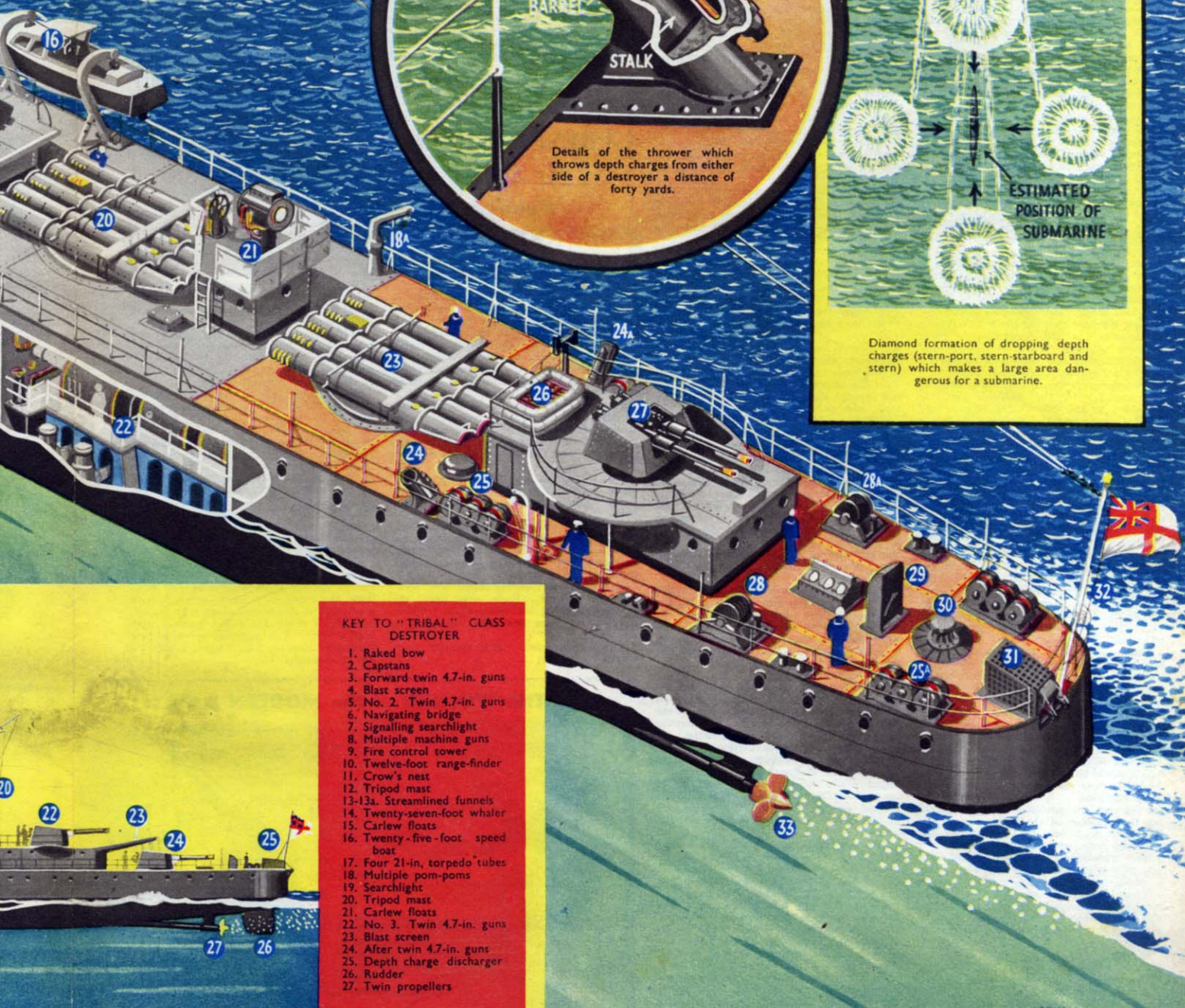
40,000 h.p. turbines will drive them at a speed of thirty-six knots. They mount six 4.7-in. guns in pairs, but by far the most interesting feature is their remarkable torpedo armament—ten 21-in. tubes in sets of five.

The other design shows one of the new super-

destroyers of the "Tribal" class—the largest destroyers yet built for the navy—1,850 tons displacement; 44,000 h.p. Chief armament, eight 4.7-in. guns and only four torpedo tubes. Carry a crew of 250. The pairing of guns on destroyers is new to the navy.



Diamond formation of dropping depth charges (stern-port, stern-starboard and stern) which makes a large area dangerous for a submarine.



KEY TO "TRIBAL" CLASS DESTROYER

1. Raked bow
2. Capstans
3. Forward twin 4.7-in. guns
4. Blast screen
5. No. 2. Twin 4.7-in. guns
6. Navigating bridge
7. Signalling searchlight
8. Multiple machine guns
9. Fire control tower
10. Twelve-foot range-finder
11. Crow's nest
12. Tripod mast
- 13-13a. Streamlined funnels
14. Twenty-seven-foot whaler
15. Carlew floats
16. Twenty-five-foot speed boat
17. Four 21-in. torpedo tubes
18. Multiple pom-poms
19. Searchlight
20. Tripod mast
21. Carlew floats
22. No. 3. Twin 4.7-in. guns
23. Blast screen
24. After twin 4.7-in. guns
25. Depth charge discharger
26. Rudder
27. Twin propellers

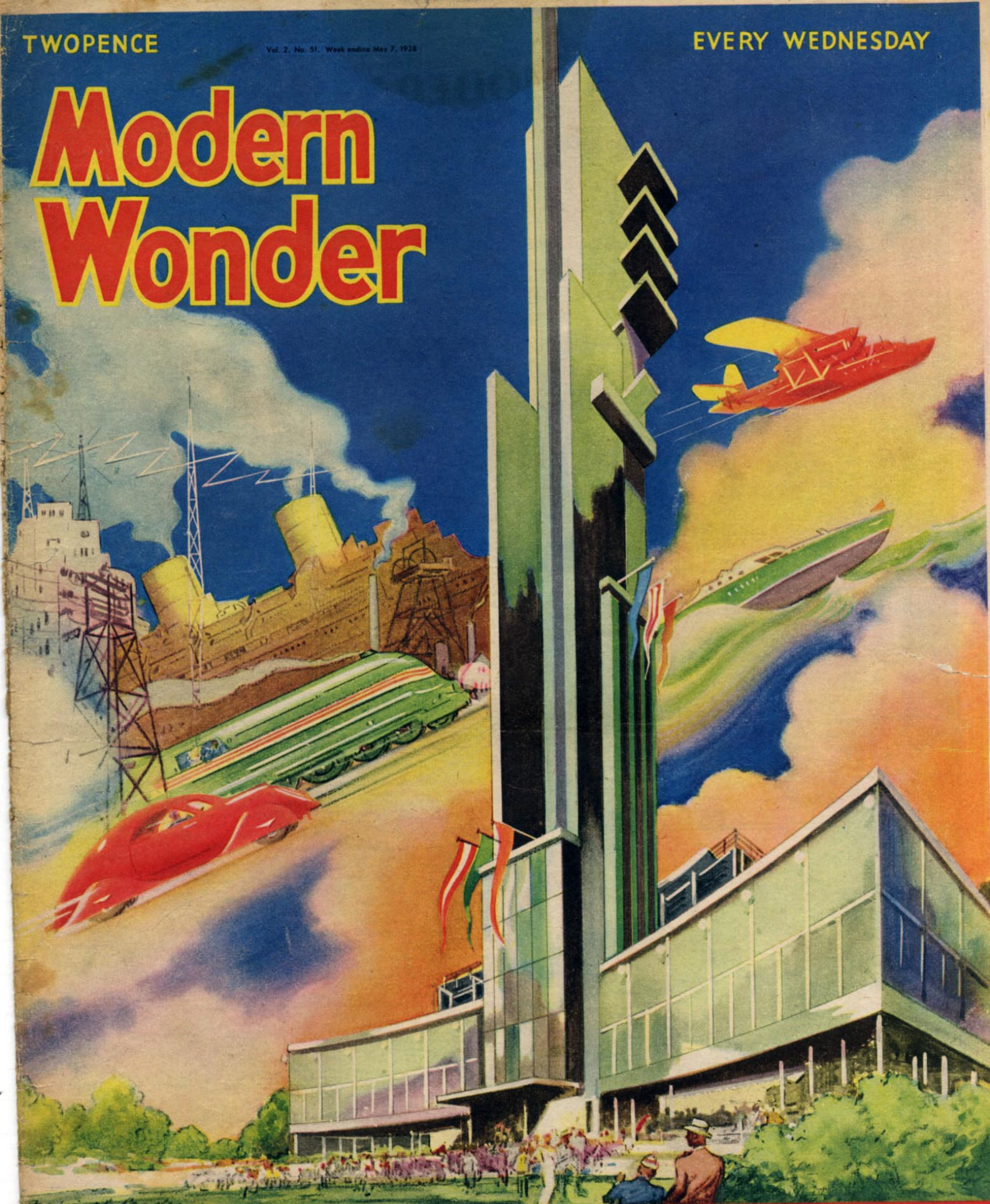
L. ASHVELL
WOOD

TWOPENCE

Vol. 2, No. 51. Week ending May 7, 1928

EVERY WEDNESDAY

Modern Wonder



THE CITY OF MODERN WONDERS !

Empire Exhibition, Glasgow Not only Scotland but the entire British Empire has good reason to be proud of the new Exhibition at Glasgow. From the great steel tower, 300 ft. in height, which can hold 600 people at the top, to the latest sideshow in the Amusement Park, a myriad marvels of modern science and engineering have been assembled. And in the halls and pavilions are reflected the ingenuity and skill of the expert craftsmen and scientists of today. Full story inside.

DIFFERENT USES FOR THE MODERN EXCAVATOR

The machine as a dragline. Here the bucket is dropped away ahead of the machine, perhaps sixty feet, according to boom length, and dragged along the ground by a steel rope. Its cutting teeth dig into the soil—maybe the bottom of a river—and it quickly fills. For emptying, it is simply turned upside down.

The dragline bucket will, with its hard steel teeth, bite into half a ton of earth and pick it up. Here are seen the hauling and supporting chains, as well as the tipping rope.

HERE is an example of a digging machine which, in one day, can do the work of forty good men. It not only digs out hard, rocky soil if necessary, but it also loads the soil into waiting lorries.

It is easily convertible into a variety of machines of similar uses, such as the dragline—shown on the left, with its bucket, and the dragshovel for trenching.

First the shovel, shown stripped of its casing in the big drawing in the centre. The dipper is fixed to a long pivoted boom, the length of which can be altered. It is hauled up by two-part rope, thus digging into the job, by the winch driven by a 70 h.p. oil engine. This gives a pull amounting to nearly twelve tons.

The dipper will hold three-quarter cubic yards of the soil, weighing perhaps twenty-five cwt. when full. Big shovels will dig out six cubic yards at a bite, and can deal with 3,500 tons of soil a day. In front of the dipper, four heavy teeth do the digging work.

The driver has ten levers and two pedals for controls, but most work is done with three levers and one brake pedal.

These machines travel entirely on crawler tracks of caterpillar type. Thus their great weight is distributed over a large area and they can work on soft ground if necessary. Steering is carried out by varying the drive to the separate tracks, and swivelling the machine is done by means of the big gear shown.

Here is the dragshovel in operation, with the cutting teeth of the dipper clearly shown. The dipper handle is carried by fixed pivots at the end of the boom, which can be lifted to any height by the pulleys and tackle. The ropes for hauling on the dipper can also be seen. The same volume of soil can be dug at one cut as by the shovelling process. A depth of eighteen feet can be reached from the ground level.

(Above) The dipper is seen commencing to dig, and on the left is seen the end of the stroke, with the dipper handle fully extended. At a given position, a trip comes into action, releasing the hinged bottom of the dipper, and the contents fall out.

"INTERVAL"

Means the space between the wing tips of aircraft flying in formation.



SINGLE-ENGINE FIGHTERS
Interval is half span of planes.

TWIN-ENGINE BOMBERS
Interval equal to one span.

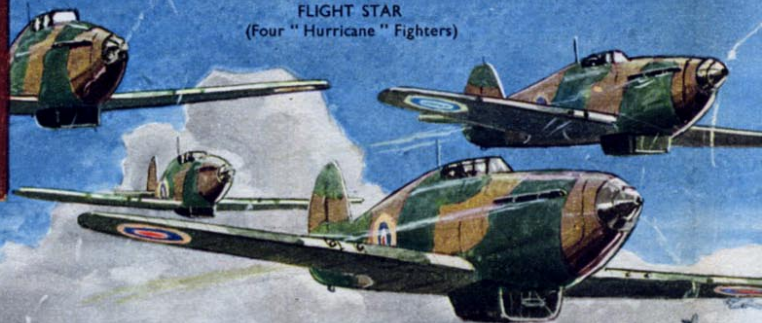


"CLOSE UP"

Flight Leader of "Gladiator" Fighters
gives the signal to close up by lifting
the plane's nose.

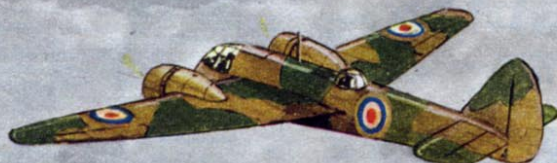


FLIGHT STAR
(Four "Hurricane" Fighters)



ECHELON—LEFT

The Squadron Leader of these
"Blenheim" Medium Bombers
is on the right of the line as
it advances.



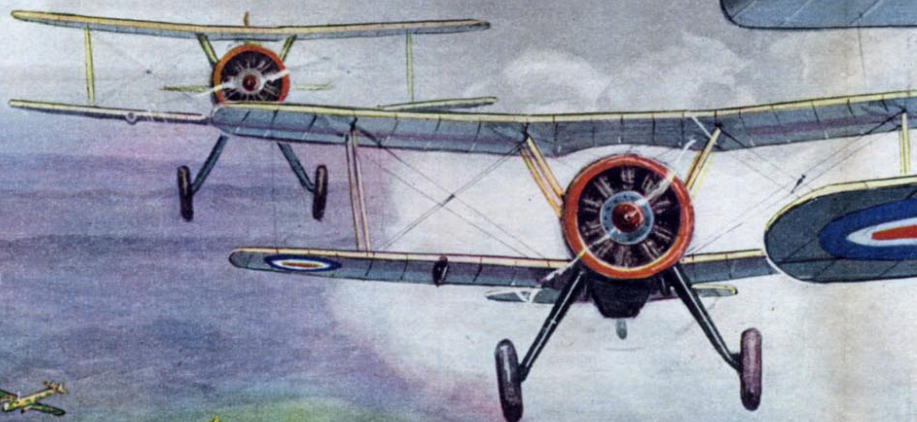
SQUADRON, LINE ASTERN

("Anson" Reconnaissance Aircraft)
A Reconnaissance Squadron consists of eighteen
aircraft.



FLIGHT, LINE ABREAST— RIGHT UP

("Wellesley" Medium Bombers)
The Flight Leader is in the lowest plane.



ASTERN—FLIGHTS ABREAST

("Whitley" Heavy Bombers)
A Bomber Squadron consists of twelve
aircraft.



A Fighter Squadron consists of fourteen aircraft.

FLIGHT LINE ASTERN—UP
("Battle" Medium Bombers)

A Bomber Flight consists of three aircraft. The leader is lower than the second plane which in turn is lower than the third.

"OPEN—I REPEAT, OPEN—GO!"

FLIGHT "VIC"
("Gladiator" Fighters)
A Fighter Flight consists of five aircraft flying in the formation of the letter "V."

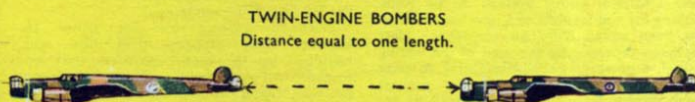
FLIGHT LINE ABREAST
("Hurricane" Fighters)

DISTANCE

Is measured from the rudder of the leading aircraft to the nose of the aircraft following.



SINGLE-ENGINE FIGHTERS
Distance equal to half a length.



TWIN-ENGINE BOMBERS
Distance equal to one length.

DRILL IN CLOUDLAND
AERIAL MANŒUVRES OF THE R.A.F.

DRILL is as necessary to the pilots of our Air Force as it is to the Army on land and the Navy at sea. It takes the form of various kinds of formation flying, of which a few are shown in the illustration. It teaches the pilots to get off in quick formation and land together tending to save a great amount of time. In the air the drill is to teach the pilots to fly close together, follow their leader who issues his commands by means of wireless and even fight together as one unit. Formation flying was first developed in the Great War but the form it took was very different from the highly specialized formation flying of today. Every pilot concentrates upon the leader and ignores the ground so that the formation becomes one body with all its members doing exactly the same manœuvre at the same time as the leader. Very close formation flying is for the experts only, but for the average pilot of the R.A.F. definite rules are laid down for space and distance between the machines and these must be rigidly followed to avoid accidents. It also teaches young pilots discipline, quickness to obey commands and the control of their aircraft in close proximity to others.

Modern Wonder

TWOPENCE
EVERY WEDNESDAY

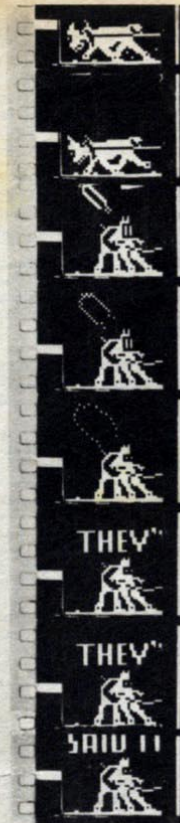
Vol. 2. No. 44. Week ending March 19, 1938



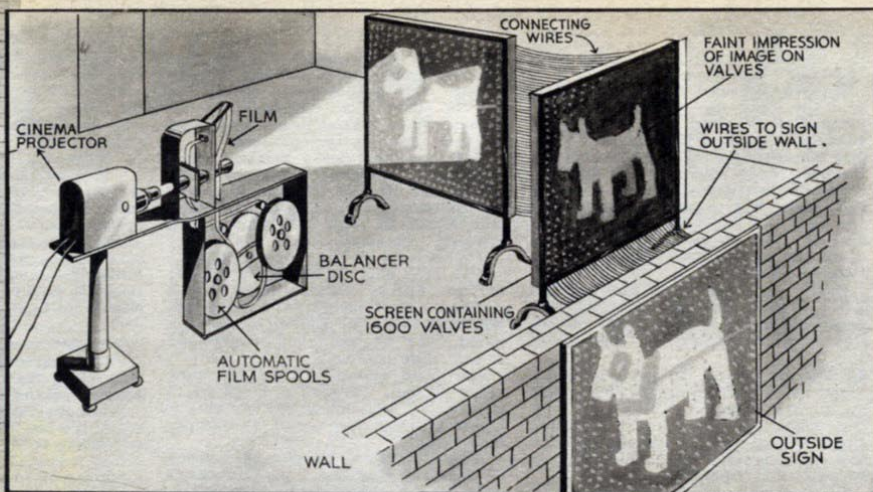
DEATH-DEALING CABLES FOR LONDON'S DEFENCE

DURING the Great War of 1914-1918 London suffered severely from air-raids, but in the event of a future war, this menace may be overcome by the use of balloon barrages. Balloons attached to lethal cables will rise to heights of between 10,000 and 20,000 feet to form a formidable barrier to heavy bombers. The balloons will keep the attackers at a height where accurate bombing is impossible, and if the enemy planes should attempt to come lower they will be destroyed immediately by the strong cables attached to the balloons. The type of lethal cable to be used is at the moment a secret. The full story of London's balloon barrage defence against air-raids is told on page 2 of this issue.

IN THIS ISSUE: BALLOON BARRAGE • THE STORY OF OIL •
MODERN WONDER NEWSREEL • STORIES AND COLOUR PAGES



W. D. & H. O. Wills's cigarette advertisement in Trafalgar Square.



(Above) The internal workings of London's moving-picture sign, showing the picture's passage from the cinema projector to the sign on the outer wall. (Left) An actual size reproduction of part of a film used in a

LONDON'S MAGIC SIGN

to move through the gate, and a moving image is projected into the room. But here the fun begins.

Instead of shining on to a silver screen, the image is focused on to a small frame, three feet square, which contains one thousand six hundred separate photo-electric cells.

According to the piece of film in front of the lens, certain of these cells are in a bright light, and others are in darkness. And each cell affected by the beam of light transmits a small electrical impulse through its own, individual circuit.

Every single photo-electric cell in the frame is connected by a separate circuit to a relay valve in yet another frame. Each relay valve is connected to a corresponding electric lamp on the screen outside.

Thus, if one were to switch off the projector, and shine the beam of an electric torch on to one photo-electric cell, the crowds waiting in the street outside would see just one lamp light up. If one waved the torch about over the frame of cells, the movement of the beam would be faithfully copied on the screen.

With the projector turning over at its normal speed of sixteen pictures per second, the lamps on the "screen" flash on and off at that same speed. The human eye does not work fast enough to detect the breaks, and the illusion of continuous motion is created.

For the projection of these giant cartoons, therefore, one thousand six hundred gas-filled photo-electric cells are needed; one thousand six hundred thyatron valves to relay the impulses; and one thousand six hundred gas-filled lamps of fifteen watts.

As each picture may well light up one thousand of the lamps, the watching eye in the street, without realizing it, sees

some sixteen thousand light flashes every second! Actually this wonder sign can do better than that if necessary. Tests have shown that it can quite well handle forty thousand flashes a second.

Anyone lucky enough to have a peep inside the control room while the show is on sees an even more fascinating sight than those watching from below. It is an example of an electrical robot at its weirdest and most wonderful task.

The room is, naturally, in darkness, for the photo-electric cells must only receive the light intended for them. If one were to switch on a light, the whole screen outside would light up too!

Through the darkness the beam of light shines from the whirling projector. The image of the film falls, flickering on the maze of cells. Again, from the big panel of thyatron relay valves, comes the uncanny effect of a "light echo"—a copy of the cartoon in blue and deep red! For the thyatrons are of the mercury type of valve, and the mercury vapour in each glows when current is passing through it.

The firm itself is non-inflammable, so that there is no danger in leaving the projector unattended. The part of the projector which might be expected to cause trouble—the spools holding an endless band of about three hundred feet of film—are very cleverly arranged.

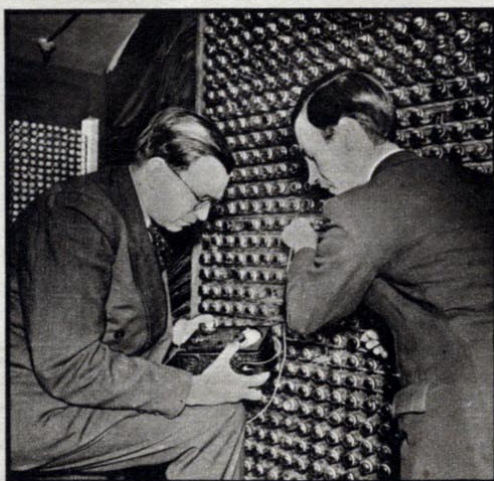
One spool feeds the film to the projector, and another reels it in. As the show nears its end, the weight of the full spool tips the empty one into position for the next run through. As with the rest of the apparatus, it is quite automatic.

The invention is the work of two Austrians, and for some time it has enthralled thousands in America. Now, for the first time, it is appearing in England. And judging by the huge interest it has created, it has come to stay. Already, British Epok, the company controlling it, are contemplating more signs in other parts of the country.

The giant Trafalgar Square sign is not only the biggest of its kind in the world, but it is also the best. In America only one photo-electric cell was used to each group of four lamps—which meant only a fourth of the good definition that London's thousands are seeing.

Artists are now hard at work in the firm's studios, drawing cartoons for future films. The complete show lasts for about three hundred seconds—at sixteen pictures per second. This means that four thousand eight hundred pictures have to be drawn by hand, and then photographed.

The neon signs above the screen are changed automatically, as the film reels through the projector. There are four advertisers to a show, and this means four separate neon signs.



Electricians testing the 1,600 thyatron valves necessary to relay electric impulses from the photo-electric cells.

HOW MUCH DO YOU KNOW?

Here is another set of questions to test your knowledge. Try to answer them before you consult the solutions

1.—What is the essential difference between a "Ford Eight" and a "Ford V-Eight"?

2.—"Like water off a duck's back" is a common phrase. Why does water fail to make a duck wet and be dragged?

3.—The sun appears a dull red when rising or setting but almost white at midday. Why is this?

4.—When setting up type for printing, the metal letters must first be cast in moulds. So that the letters shall be perfectly formed the metal must be one which has the unusual property of expanding as it solidifies, thus exactly filling the mould. What metal is used for this purpose?

5.—For what great firm do the letters I.C.I. stand?

6.—Where is the game called *shinty* most popular, and how is it played?

7.—What is the origin of the coral reefs of the South Seas?

8.—Wireless waves are of the same general nature as light; they travel in straight lines and they will not penetrate many miles of the earth's crust. How is it then, that we can send wireless messages to places on the opposite side of the world?

9.—At present, most of the world's power is obtained from coal, oil, and rain-water falling on high ground. The first two sources are bound to be exhausted within a few hundred years, more or less, and the last is not unlimited. Where are we likely to look next for our sources of power?



How Much Did You Know?

1.—A Ford Eight is the eight horse-power car, while the V-Eight is the much larger and more powerful eight-cylinder car; the latter is rated at either twenty-two or thirty horse-power.

2.—The feathers of the duck and other water-fowl contain a natural grease to which water will not cling. It is for a similar reason that it is so hard to wash oily hands.

3.—The light from the sun is a mixture of all the colours of the rainbow, but of these, the blue rays are most absorbed and scattered by the atmosphere of the earth. When the sun is low on the horizon, the rays have to pass through a much greater depth of air than they do at midday, and so more of the blue light is removed and a greater part of what is left is red.

4.—Type metal is an alloy of lead (about seventy-five per cent), antimony (twenty per cent), tin (five per cent). Antimony is an element of similar nature to arsenic and has the important property of expanding on turning from liquid into solid as also do its alloys.

5.—Imperial Chemical Industries Ltd., a firm with a capital running into hundreds of millions and with dozens of factories and branches in England alone. Chemicals, artificial manures, explosives, "Nobel" cartridges, "Revine" leather-cloth are a very few of its products.

6.—*Shinty* is played chiefly in Scotland; it is a game rather like hockey but played with a much softer ball. Both sides of the stick may be used and there are comparatively few rules and regulations.

7.—Coral consists of the tiny remains of minute sea creatures called *Zoophytes* or *Coral Polyps*. These can only flourish in fairly shallow water, and as they die, their descendants live and grow on top of them. When the "reef" reaches the surface of the water, after a great many years, the little animals die and the reef stops growing.

If a reef stands well out of the water, it is due to a rising of the sea bed at that point.

8.—At a height of about sixty miles there appears to be a layer of atoms of air split up into charged particles by radiations from the sun. This acts as a kind of mirror which reflects wireless waves back to the earth again; they may be reflected up and down several times. Very short wireless waves tend to pierce this "Kennelly-Heaviside" layer but are reflected by the "Appleton" layer which is rather similar but at a height of about one hundred and fifty miles.

9.—The tides can be harnessed by letting them work turbine engines as the water rushes in and out of estuaries like that of the Severn. Great windmills could be built. The rays of the sun could be focused by mirrors to heat water for steam-engines, as is already done to some extent in Egypt today. There is also a possibility of using the vast stores of energy contained within the atoms of substances—there is said to be enough of this energy in an ordinary brick to take a liner across the Atlantic.

THE FRENCH BATTLESHIP "LORRAINE" IN 1918



FRENCH BATTLESHIP "LORRAINE" AS SHE IS TODAY

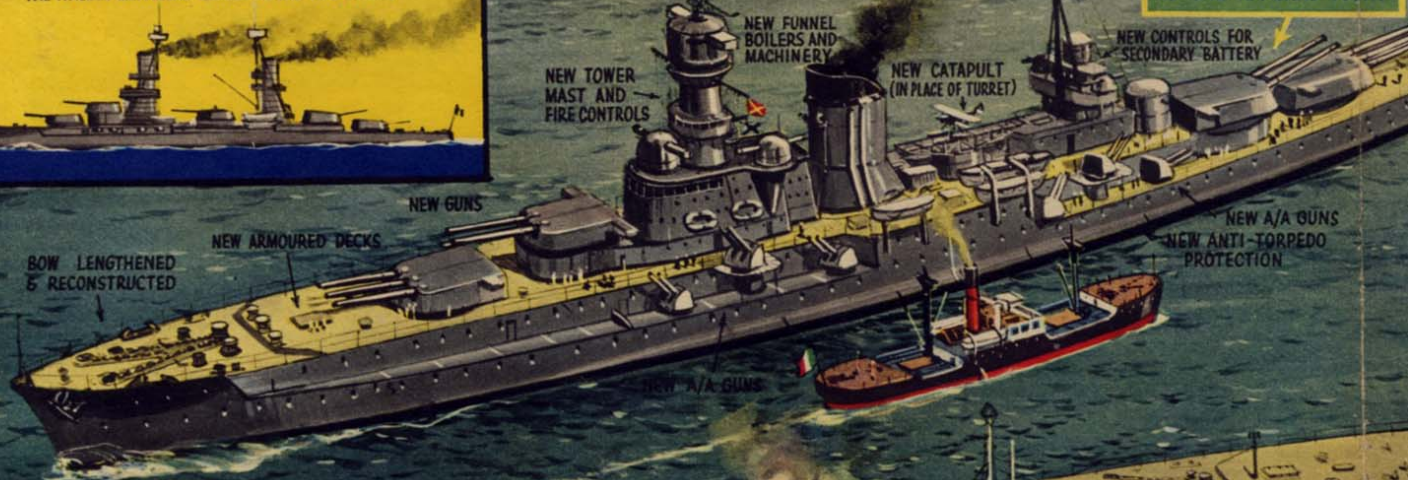


THE MINAS GERAIS AS SHE WAS

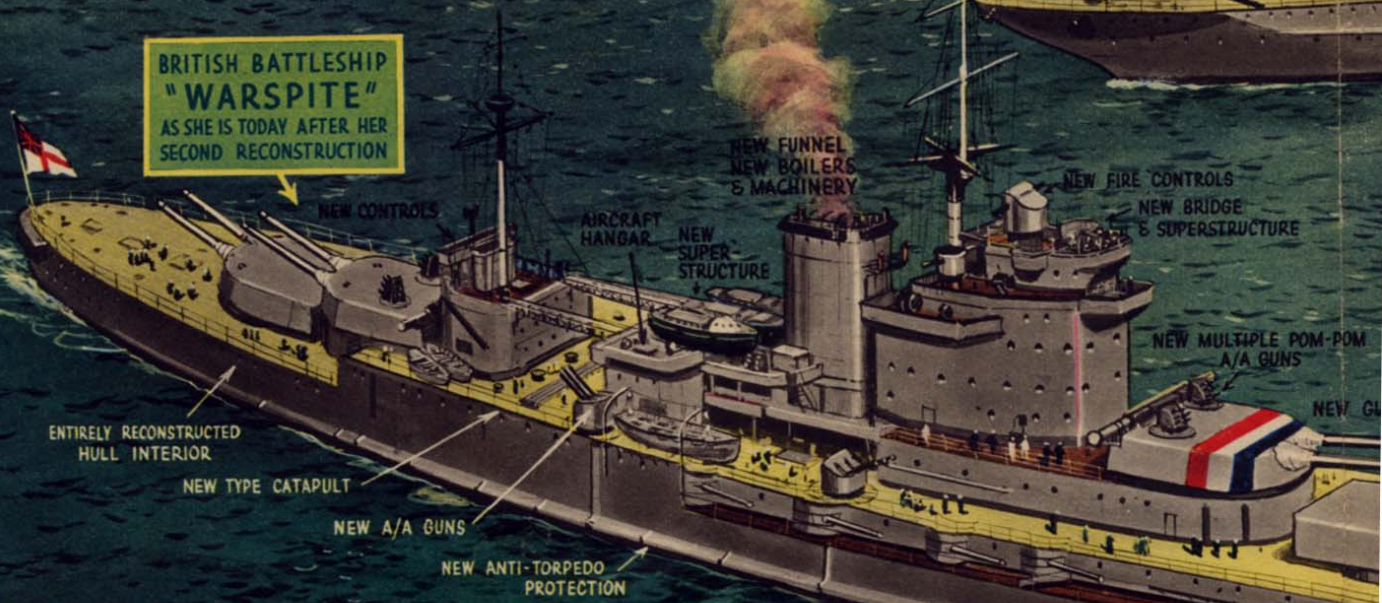


ITALIAN BATTLESHIP "CAVOUR" AS SHE APPEARS TODAY

THE ITALIAN BATTLESHIP CAVOUR AS SHE WAS IN 1918



BRITISH BATTLESHIP "WARSPITE" AS SHE IS TODAY AFTER HER SECOND RECONSTRUCTION



H.M.S. WARSPITE AS SHE APPEARED IN 1928, AFTER HER FIRST RECONSTRUCTION



BATTLESHIP RECONSTRUCTION

THE "Naval Holiday" agreed upon between the great powers and known as the Washington Treaty, limited the building of fighting ships for many years, and the building of capital ships was entirely suspended, only France and Italy being allowed to build two replacement battleships each.

During this time the Powers were compelled to turn to the reconstruction of old ships.

This state of affairs held good right up to some two years ago when the rearmament race started again and now all the chief naval countries are engaged in feverishly building new great fighting ships.

The British battleship Warspite was originally laid down in October, 1912 and completed in March, 1915. She took part in the Great War and played a

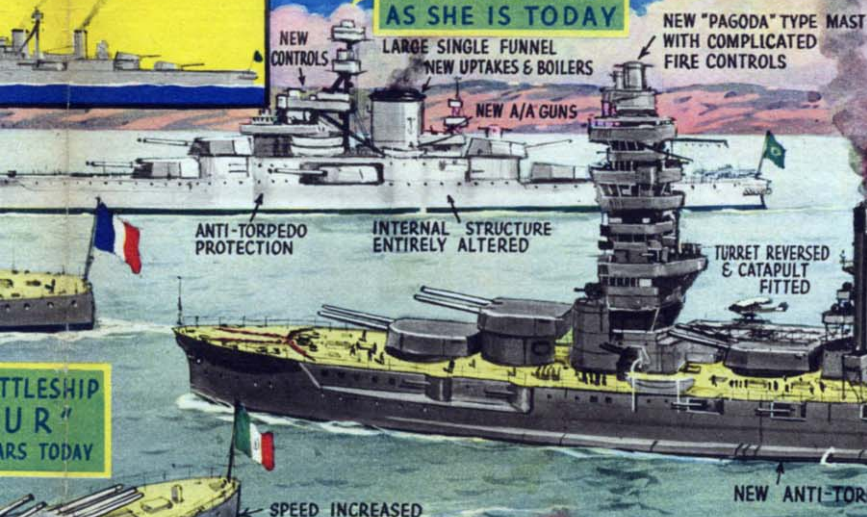
prominent part at the battle of Jutland. In 1925 she was taken into dockyard hands and reconstructed and her appearance altered.

Just over ten years later she was again ready for refitting and was practically stripped, new boilers and machinery were fitted and increased anti-aircraft and anti-torpedo protection provided.

Another great feat in reconstruction is that of the Italian battleship Cavour and her sister the Cesare launched in 1911. At that time these ships each displaced 21,000 tons and had a speed of 21 knots.

GERAIS AS SHE WAS IN 1918

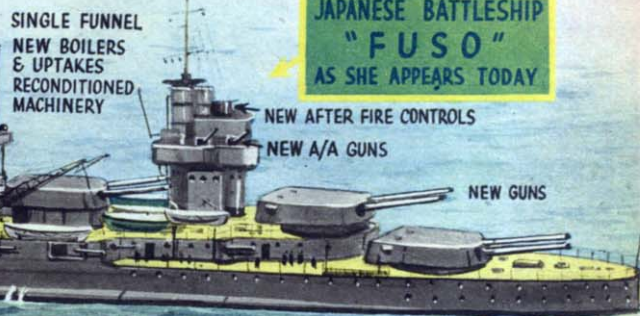
BRAZILIAN BATTLESHIP "MINAS GERAIS" AS SHE IS TODAY



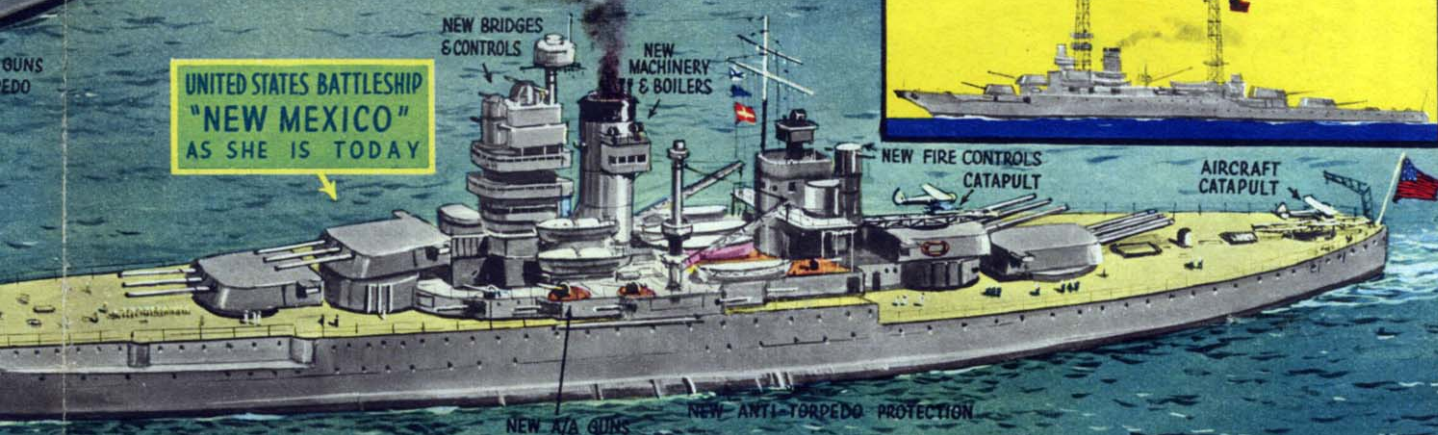
JAPANESE BATTLESHIP FUSO IN 1918



JAPANESE BATTLESHIP "FUSO" AS SHE APPEARS TODAY



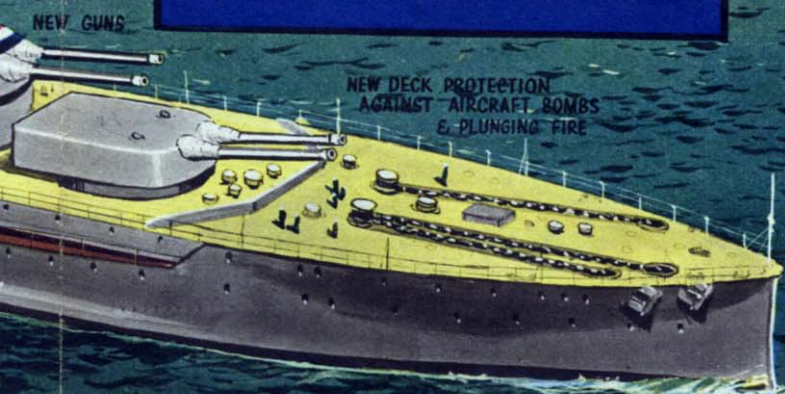
UNITED STATES BATTLESHIP "NEW MEXICO" AS SHE IS TODAY



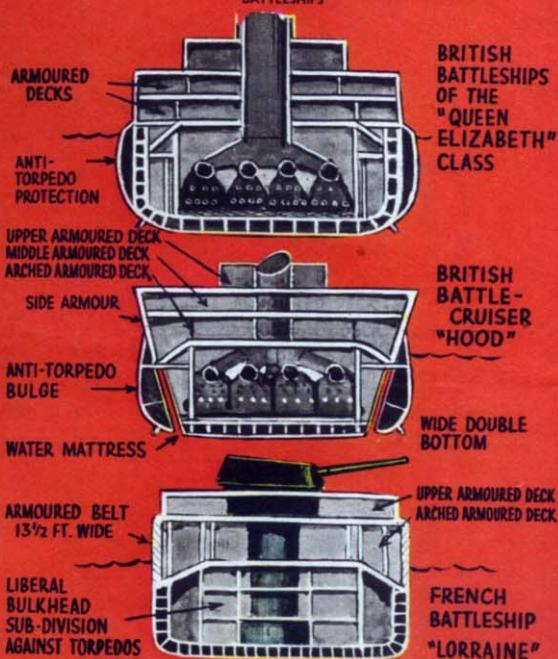
UNITED STATES BATTLESHIP NEW MEXICO IN 1918



BRITISH BATTLESHIP WARSPITE AS SHE ORIGINALLY APPEARED IN 1918



NEW ANTI-TORPEDO AND ANTI-AIRCRAFT PROTECTION FOR RECONDITIONED BATTLESHIPS



They have been lengthened, rearmoured and are now of 25,000 tons displacement, and with modern engines and boilers they can steam at 26 knots.

Yet again, look at the altered appearance of the Japanese Fuso now provided with an elaborate pagoda-like structure to house her numerous controls. New boilers of the latest type have increased the space available for other items below her rearmoured

decks and now she needs only one funnel. Observe the altered appearance of the Brazilian battleship Minas Gerais which was built at Elswick on the Tyne and completed no less than twenty-seven years ago.

Note the altered appearance of the reconditioned United States' battleship New Mexico, originally completed in 1917 and today one of the most powerful fighting machines afloat.

TWOPENCE

Vol. 2, No. 40. Week ending February 19, 1938.

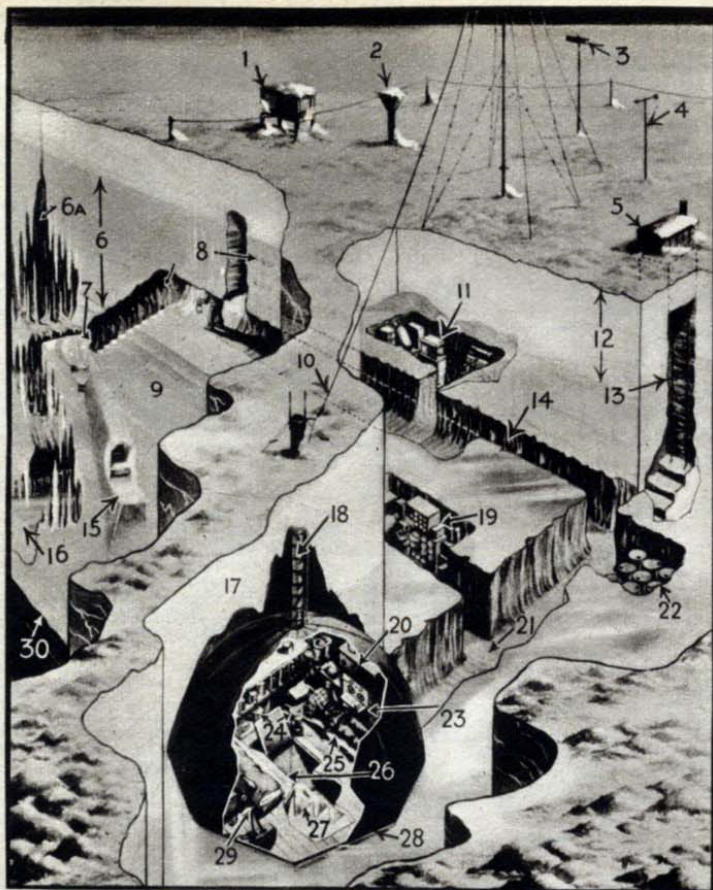
EVERY WEDNESDAY

Modern Wonder



Frederick Fante

**In this issue: BIG GUNS OF THE AIR • LIVING UNDER THE ICE •
STREAMLINED LINER OF THE FUTURE • MAN-MADE RIVER THROUGH
MOUNTAINS AND DESERTS • THRILLING STORIES AND COLOUR PAGES**



(Left) Sectional view of the ice-cap station, reproduced by courtesy of "Illustrated London News."



The M.S. Polar, the Norwegian ship used by the members of the Oxford University Expedition.

LIVING UNDER the ICE

TWO young men sat one Saturday night listening to the dance music that was being broadcast from a West End hotel. And never can hot rhythm have been heard in colder surroundings, for the room in which they sat had been cut of solid Arctic ice.

They were members of the Oxford University Arctic Expedition of 1935-6, and their strange home beneath the ground was on an ice-cap in North East Land which lies on the 80th Parallel and adjoins Spitzbergen. It is only some five hundred and seventy miles from the North Pole itself, and it is in those bleak regions that our weather is born.

The main objects of the expedition were twofold. First, it was intended to establish a meteorological station that would play a big part in improving the accuracy of weather forecasting, and secondly, the members of the expedition proposed to carry out extensive research work in geology and glaciology.

Excellent ideals, but exceedingly difficult to fulfil. In a desolate land where the wild winter storms rage fiercely for days on end and intense cold persists, it is impossible to live in the howling wilderness of ice and snow.

However, the very bleakness of the terrain provided its own solution. Ice of incredible thickness was everywhere, and in the ice itself might be found a shelter from the mighty winds that often raged at one hundred miles an hour and protection from a surface frost that reached seventy degrees.

Thus it was that the ten members of the expedition decided to build an underground domain in which they could live by turns.

Mr. A. R. Glen, the leader of the expedition gives a vivid account of this strange underground post and the life lived by the modern troglodytes who inhabited it. Indeed, the two chapters he devotes to this part of the expedition's activities are among the most enthralling in the whole of the book, *Under the Pole Star* (Methuen 25/-) which he has written assisted by Mr. N. A. C. Croft.

Incidentally, Mr. Croft who was the second in command, took many of the striking photographs with which this comprehensive account of the expedition's activities is illustrated.

Naturally, the work of constructing this underground station was slow. For one thing, there was no room in which to wield pickaxes, and small chisels had to be used, for although spades would break up the "firm," they were no use in breaking the clear ice.

Firm is a collection of small ice crystals

REMARKABLE ARCTIC WEATHER STATION

each of which is separated from its neighbours by a thin layer of air. Unlike pure ice which is of a clear, vivid blue, it is white and opaque in the light and is broken with comparative ease.

The first part of the work consisted of digging a pit some four feet in depth. Into this was inserted a strong tent in such a way that only the roof protruded above the surface and a wooden floor was fitted at the bottom of the pit.

Then the tunnelling started in earnest. In the wooden floor was a trap door leading to steps cut out of the solid ice, and these in their turn led to a passage twenty-five feet long which ended in a right-angled turn.

Here was built a shaft that thrust upwards through the ice and then the snow to the surface, for constant falls of snow were soon to bury the tent itself, for which a steam and air vent was improvised from empty tins.

A second passage, forty feet long was built and off it were made a safety cavern to house a spare tent and stores, and holes in the walls of ice for thermometers. In the first passage were the general food stores and the paraffin oil stores.

When this strange ice station had been finished, the wireless was installed and, on the ground immediately overhead were set up the scientific instruments. They included a case of meteorological instruments, the wireless transmitting and receiving aerial, a snow fall indicator, a wind speed indicator and a wind direction indicator.

Over forty tons of snow and ice were removed in the construction of this warren, but the result was well worth the labour. Even when the cold was at its worst outside, the temperature in the ice-cap home never once fell below freezing point, in fact, the difference between the inside and outside temperatures was often as great as one hundred and twenty degrees Fahrenheit.

Although Robert Moss, the physicist of the expedition, lived in the underground home for ten months, the other members took it in turns to travel to and from the base to take over their share of duty. And very trying duty it often was, for the instruments had to be examined at regular intervals.

Later on, another ice-cap station was built and this functioned every bit as satisfactorily as the first. Meteorological readings were made every day at seven a.m., midday and

at five p.m., and these three events formed the highlights of the day's work.

These readings included taking temperature records, and examining the self-registering instruments inside the Stevenson Screen. Then the wind force had to be recorded on the anemometer. It seems a simple matter when you read it in print, but actually the work was anything but pleasant out there in that abomination of freezing desolation. But let the author tell you in his own words what such work involved.

"The Stevenson Screen," he writes, "resembles a meat safe, with louvers on each of the sides to allow free passage of air, so that the smallest variation in temperature or humidity may be recorded. . . . The screen had continually to be cleaned out; often it was necessary to cut away a solid block of hard-packed snow. Doing this in a blizzard was one of the more unpleasant tasks."

"One of the more unpleasant tasks" seems a gross understatement when you realize all that it involved. But the author has a pleasant way of making light of even the most trying experiences that the members of the expedition encountered. He goes on to say:

"The torch had to be balanced on the edge, jammed into position by one's elbow, which alone prevented its being blown away by the wind. Meanwhile one hacked with a knife, while the eddies, whirling around, blew the particles into one's face. The driving snow of a blizzard cuts the face like a whip-lash, and the cold freezes cheeks and nose. One's wind-proof hood soon becomes a mass of frozen snow, through which one peers with ice-ringed eyes. Such is arctic meteorology."

The self-registering instruments caused the party a lot of bother because the continuous care they required could not be given to them anywhere except in the open. Had they been carried inside, the moisture would naturally condense on their cold surfaces and when they were taken outside again, they would have frozen immediately.

So the work had to be done in the open, and the task of making delicate adjustments with bare fingers when the temperature had reached seventy degrees of frost was a labour that might have proved too much for Hercules himself. No wonder that frobbotten

hands were all too often the unjust reward for such careful work.

Life below ground must often have been very irksome, but there was always something that could be done if anyone had the energy. The passages were often in need of minor improvements; temperature readings could be taken deep down in the ice; a chronometer watch could be repaired or the ventilator lengthened as the snow piled up outside.

Then again, water for drinking could be collected. This was a simple matter; all one had to do was to go into one of the passages, chip off a bit of the wall, and there you were! The passages, incidentally, were always intensely silent. A blizzard might be raging overhead filling the air with the thunder of the Arctic winds, but no sound penetrated the walls of ice, and there complete silence reigned.

Sundays were always kept in some state. The floor of the tent would be cleared, a home-made table set up, chairs placed round it and the one formal meal of the week would be served. The stores included a great variety of food, but appetites were apt to become dull and then a surprise item would be welcomed on the menu.

One of the culinary highlights was "George." George was, or had been, a reindeer of uncertain years and had been presented to Robert Moss in the hope that a welcome change of diet might result from the gift. George was doubtless a popular success as a reindeer, but as the main item of a Sunday's menu, he was, unhappily, a complete flop. In fact, poor George was found to taste like nothing so much as an old and mildewed goat!

That the expedition did wonderful work during the long months in the frozen north is proved by the record that is included in this fascinating book. Apart from a large survey being carried out, geological structure was mapped in detail, observations on refraction and on terrestrial magnetism were made, and meteorological records from the base were wireless back three times a day.

Also, a study was made of animal life, and observations on the aurora, atmosphere ozone, and sea-ice were carried out.

Such work calls for patience, courage and self-sacrifice of no mean order and these qualities are reflected in the pages of *Under the Pole Star*. And that was why two young men were listening to hot rhythm in a house of ice, instead of dancing to it on the parquet floor of a fashionable hotel. But to the enthusiast, hardship is a small price to pay in the interests of Science.

KEY TO SECTIONAL VIEW OF ICE-CAP STATION.

1. Case of meteorological instruments
2. Snow-fall indicator
3. Wind direction indicator
4. Wind speed indicator
5. Trap-door made from packing case
6. Firm ice 20 feet deep, with streaks of blue ice
- 6a. Crevasse
7. Emergency exit
8. Holes in ice walls for thermometers, etc
9. Strata of blue ice
10. Lead-in from aerial
11. Spare tent and stores in safety cavern
12. Snow 10 feet deep
13. Entrance shaft 18 feet deep
14. Passage 40 feet long to top of steps
15. End of shaft
16. Sunken lake 70 feet below surface
17. Snow and ice thawed by heat from tent
18. Air and steam vent made from empty tins
19. General food stores
20. Wireless receiver
21. Passage 25 feet long
22. Paraffin oil stoves
23. Wireless transmitter
24. Cooking utensils
25. Camp bed
26. Trap-door to passage below
27. Steps
28. Wooden floor of tent 18 feet below surface
29. Bicycle used for generating wireless current
30. Ground level

Photographs reproduced by courtesy of Messrs. Methuen & Co., Ltd.

A WINTER SCENE.

Reading the instruments in the darkness of an Arctic noon-day in winter.



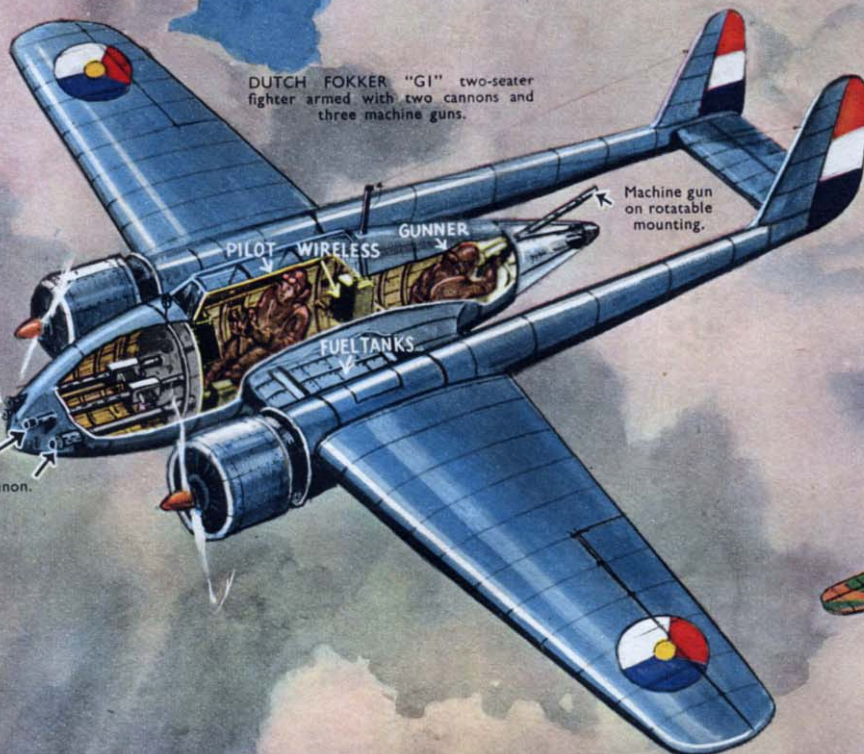
BIG GUNS OF THE AIR— CANNONS FOR AIR

Cannon firing
through boss of
airscrew.



FRENCH DEWOITINE "D500"
fighter with Hispano-Suiza cannon
firing through the centre of the
airscrew.

DUTCH FOKKER "G1" two-seater
fighter armed with two cannons and
three machine guns.

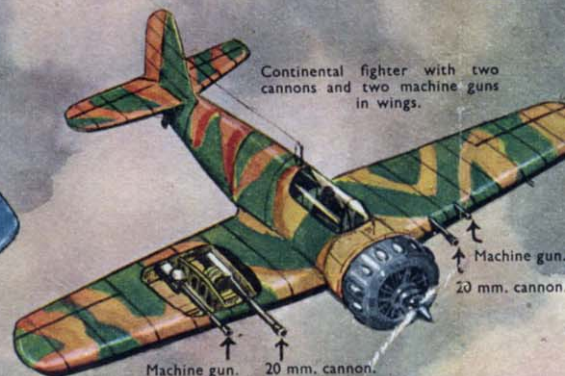


Machine gun.
23 mm. Madsen cannon.
Machine gun.
23 mm. Madsen cannon.

PILOT WIRELESS GUNNER
FUEL TANKS

Machine gun
on rotatable
mounting.

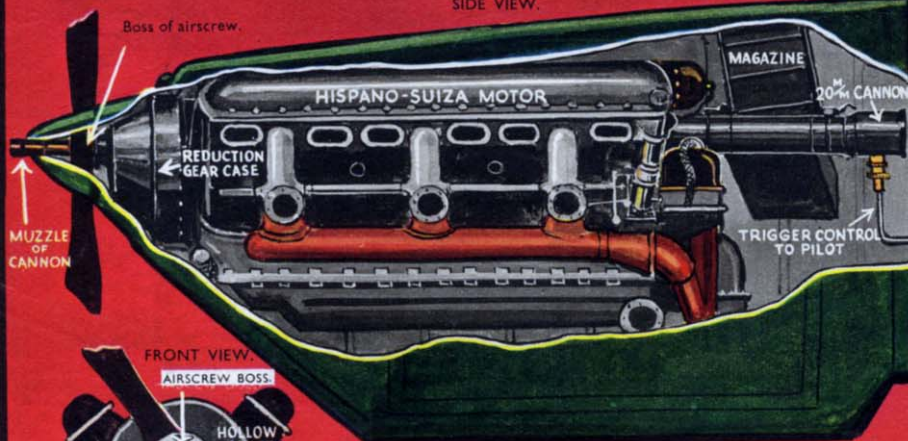
Continental fighter with two
cannons and two machine guns
in wings.



Machine gun.
20 mm. cannon.
Machine gun.
20 mm. cannon.

HISPANO-SUIZA "V" MOTOR with cannon firing through the boss of the airscrew.

SIDE VIEW.



FRONT VIEW.
AIRSCREW BOSS.



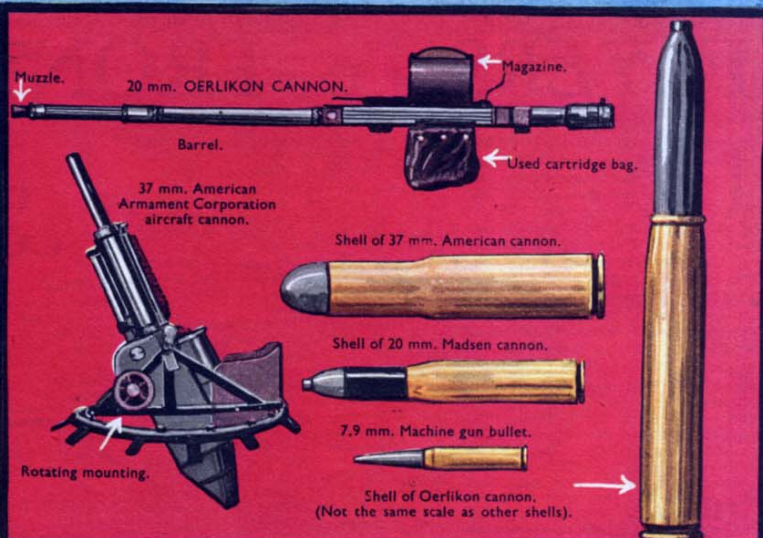
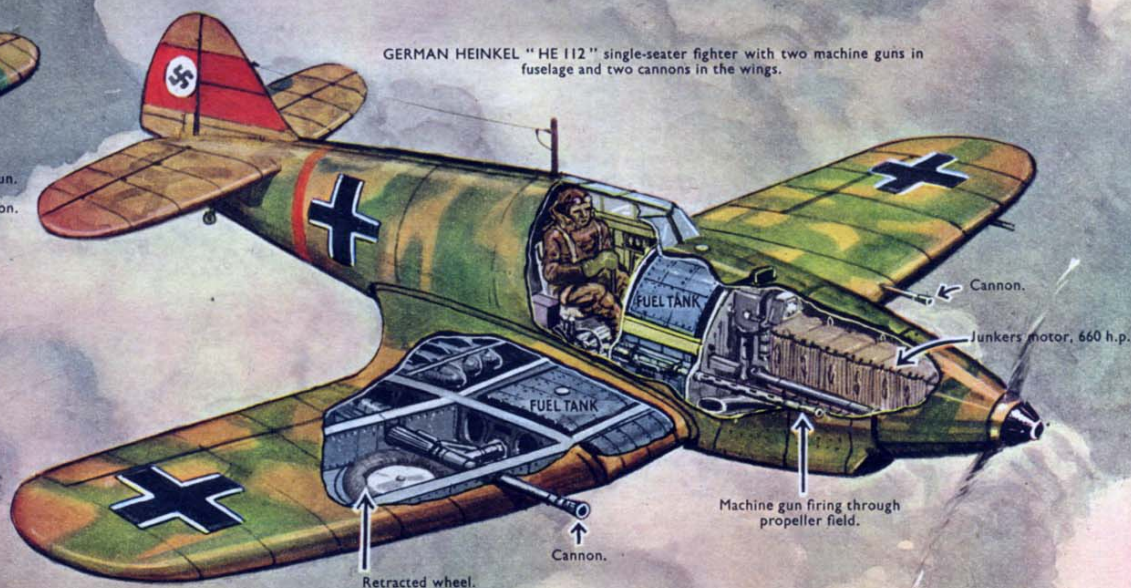
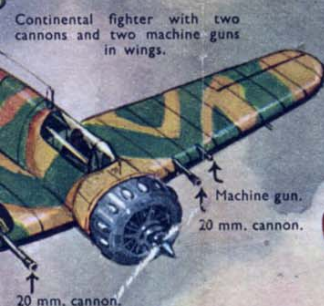
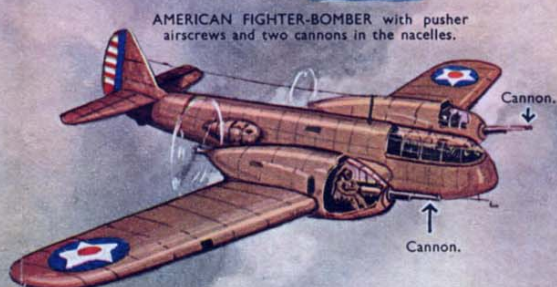
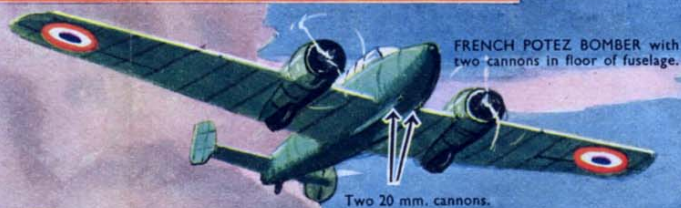
Reduction gear.

TOP VIEW.

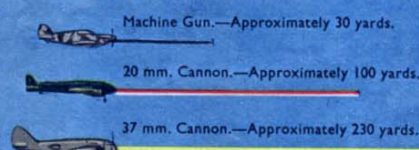
Magazine.



IR- FOR AIRCRAFT



EFFECTIVE RANGES OF CANNON AND MACHINE GUNS COMPARED.



ALL modern fighting aircraft have in recent years been fitted with multiple machine guns, but more recently "cannon" has been introduced for fitting to aeroplanes, and is much favoured in the Continental air forces. In the illustration is shown various methods devised for carrying these new and very deadly weapons.

The introduction of the cannon has also altered the design of aero engines and one particular motor made in France is specially adapted for cannon firing through the centre, or "boss," of the airscrew. In the lower inset illustration is shown an Hispano-Suiza motor with a cannon placed between the "V"-shaped port and starboard banks of cylinders.

The upper gear wheel of the propeller reduction-gear is

mounted on a hollow shaft with the barrel of the gun passing through this hollow shaft and the muzzle projecting beyond the boss of the propeller.

In other instances the guns are placed in the wings, under the floor below the pilot and in the engine nacelles. The shells burst on impact with even the thinnest fabric and even the 20 mm. shells can have a disabling effect if they hit any vital spot, whereas it takes scores of machine gun bullets to bring down an aeroplane unless the pilot or the motor receives a direct hit.

The 37 mm. which can at present only be mounted in large aircraft is a particularly deadly weapon.

CAMERA that CATCHES PLANT GROWTH

Marvels of Slow-motion Photography

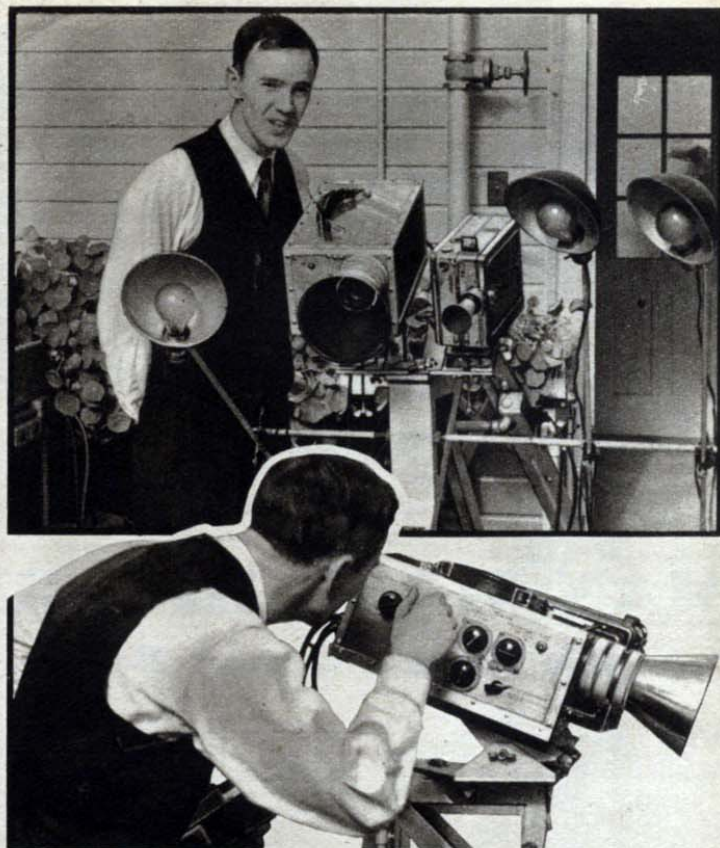
A YOUNG scientist of Rutgers University, New Brunswick, U.S.A., has just invented a new device for taking stop-action films, those fascinating picture strips which, within the space of a few minutes, show the germination of seeds, the blooming of flowers, and other actions, which normally take hundreds of times longer to develop.

On the cam shaft outside a spring driven camera, a claw mechanism is fixed which can be released by a lever controlled by an electro-magnet.

As soon as the latter receives an impulse, the cam revolves and allows the exposure of one frame, drawing another into place.

Fixed on a stand with the ciné-camera is a box which may be called the "electric-mechanical brain" of the device. Built into it are a system of relays and a clock-work device, by which combination it is possible to vary the time intervals of exposure in accordance with the speed of the growth of the plant, and which starts all other necessary actions.

The four top photographs in the strip on the left show stages in the growth of the germinating bean, while those immediately below are of lilac blooming. The pictures are not consecutive, but individual photographs extracted from a considerable length of film.



Here is the young American inventor with his time-lapse ciné-camera by means of which he photographs growing plants and flowers. How his remarkable results are obtained is fully described in the article on this page.

In order to obtain uniform exposures by day and night, this time-lapse photography has to be done by artificial light. As, on the other hand, all plants require daylight for their growth, the films have to be taken in a room with plenty of daylight, but which can be excluded or screened off a few seconds before each exposure.

A blind, operating by an electro-motor, performs this task at the right times. Then

the lights are automatically switched on and the exposure follows. The lights are again switched off and the blinds raised. This procedure is repeated at the desired time intervals.

The inventor has also built into the box a focusing device, as exact focusing is very essential when making stop-action films. An elaborate system of knobs and switches permits the exact setting of all desired actions.

KEY TO SECTIONAL VIEW

- | | | |
|---|--|---|
| 1. Whaleback | 14. Funnel flaps | 30. 3,500 kilowatt auxiliary turbo-generators (port side) |
| 2. Breakwater | 15. Games deck | 31. No. 1 power room |
| 3. Navigating bridge | 16. Lounge | 32. Oil fuel tanks |
| 4. Air intake vents | 17. Lifeboats | 33. No. 2 power room |
| 5. Sliding docking wing in extended position | 18. Drawing room | 34. No. 3 power room |
| 6. Telescopic steel mast | 19. Grill room | 35. Control platform and switch boards |
| 7. Navigating lights | 20. State rooms | 36. Motor exciter units |
| 8. Glass roof to lounges, games deck, etc. | 21. Stores | 37. Propulsion motors of 66,600 h.p. each |
| 9. Gymnasium | 22. Funnel uptake | 38. Port propellers |
| 10. Draught tunnels | 23. Pantries | 39. Exhaust pipe exit |
| 11. Wireless gear | 24. Restaurant | 40. Clear decks aft |
| 12. Detachable funnel stowed and gases forced aft | 25. Kitchens | 41. Gases passing to exhaust pipes aft |
| 13. Top hamper | 26. Bathrooms | |
| | 27. Swimming pool | |
| | 28. 51,000 kilowatt turbo-generators (port side) | |
| | 29. Patent fuel valve boilers | |



TRANSATLANTIC LINER of the FUTURE

STREAMLINED THROUGHOUT

THE big ocean-going liner as we know it today, is passing. Probably never again—after the present building programmes are finished—shall we see a liner like the *Queen Mary* or the *Normandie* sliding down the slipway to the sea.

A problem that is giving all the marine architects in the world a perpetual headache has arisen to write "finis" to the chapter of the ocean greyhounds.

It is a problem that heralded itself last year with the sunlight on silver wings and the roaring of two thousand horse power—the problem of air transport.

As affairs stand, the ocean-going liner—particularly over the Atlantic—hasn't a ghost of a chance against the new type sky clippers which are at the present time being constructed.

Already the American Government is seriously considering switching steamship line subsidies to the Atlantic airlines.

Their economists have worked out that it would be cheaper for them to do so. Here are some facts:—

A fleet of five fifty-passenger flying boats running three services a week can clear much more profit than one liner—and costs less to build.

That goes just for the Atlantic. From other shipping lines, the established air routes have already snatched the cream of the first class traffic. The reason is that it's cheaper to fly—there aren't so many tips, so many expenses—and it's much quicker, very much more convenient.

Naturally, this is a serious position for the shipowners. It is not at all pleasant for the controllers of a transport system worth many millions of pounds to have

to sit back and watch a thirty-five-year-old upstart beginning to snatch everything for which they've worked. Especially if they pause to think that only five years ago they were splitting their sides with laughter at the bare idea of the possibility of air transport ever becoming a serious rival to the ocean ship lanes.

Well, the idea isn't so absurd now. The big ship men have had to get down to some serious thinking. And they have thought to some purpose. They've produced an idea for an entirely new kind of ship—a liner that wasn't even thought about in 1930, when everyone considered the *Queen Mary* to be the last word in modern ocean-going vessels.

Prominent members of the Institute of Marine Engineers are behind the idea. One is an Englishman, A. C. Hardie, B.Sc., and the other a Frenchman, Pierre de Malglaive, B.Sc. These men are at the head of their profession, and are to be taken with the utmost seriousness.

They have designed a ship for the Atlantic crossing that will:—

Be capable of a speed four or five knots in excess of anything now considered possible.

Should be able to meet air competition satisfactorily.

Be more comfortable in bad weather than any ship now sailing the ocean.

Let's have a look at this engineering miracle. To begin with, it will be a giant

streamlined hull. There are no funnels and none of the usual excrescences. When the ship is moving, these all retract below decks.

The superstructure itself will be streamlined down to the last inch and—very important this—will be made of the new toughened glass to a great extent.

In port, the engine-room gases will be got rid of through flaps on the top of the superstructure. At sea, they will be let out astern through huge exhaust pipes in the same way as a car rids itself of its exhaust gases.

The glass covering will allow the passengers the greatest possible amount of light in all weathers without spoiling the streamline effect of the ship.

Air for ventilation will be taken in forward through automobile type vents.

Even the signalling mast will be telescopic, reducing wind resistance when it isn't needed.

Now, in order to meet air competition from flying boats and big airships, the liner should be able to give a three and a half day—or eighty-four hour—service from quay to quay, from Plymouth to New York.

This schedule would demand a speed throughout the trip of thirty-five to thirty-seven knots. This speed makes, present blue riband records look absurd.

But even with this speed, the crossing would still take twenty-four hours longer than an air service schedule.

So there must be something else to compensate for the extra time.

The designers consider that they have found this with the increased comfort they can offer. This means not only comfort in more spacious accommodation for the passengers—such as bigger cabins, public rooms, swimming pools and so on—but physical comfort, especially in very bad weather.

To achieve this result, giant anti-rolling tanks would be fitted. These tanks, in the sides of the big hull, tend to absorb wave forces and actually damp the roll of the ship by making it semi-waterlogged—in the special compartment—during storms.

To aid the anti-rolling tanks, great gyro-stabilizers would be fitted as well. These, working on the gyroscope principle, would naturally tend to keep the ship on an even keel whatever were the outside forces trying to push it off.

To achieve these results, the ship would have to be 1,100 feet long at least. The *Queen Mary* measures 1,020 feet.

This size means a very big ship indeed. And very big ships cost money. What kind of bill would the shipping lines have to foot for an ocean liner of this type?

Well, at a conservative estimate, the cost would be well over £3,000,000, maybe nearer £4,000,000. The machinery alone would cost £1,750,000. This would be either Diesel or petrol electric. It may even be of a new type of oil-burner steam turbine, but this is out of date and therefore doubtful.

Who would pay this vast amount for a ship nowadays? No single shipping company could afford it. But the designers have a solution to this problem as well.

They say that even today mammoth liners are paid for by nations rather than by companies. In other words, government subsidies pay for the *Queen Marys* and the *Normandies* of the world. And if the governments place enough importance on the big ships to pay a subsidy for them as they stand now, it seems reasonable that they would pay a subsidy for the ships of the future.

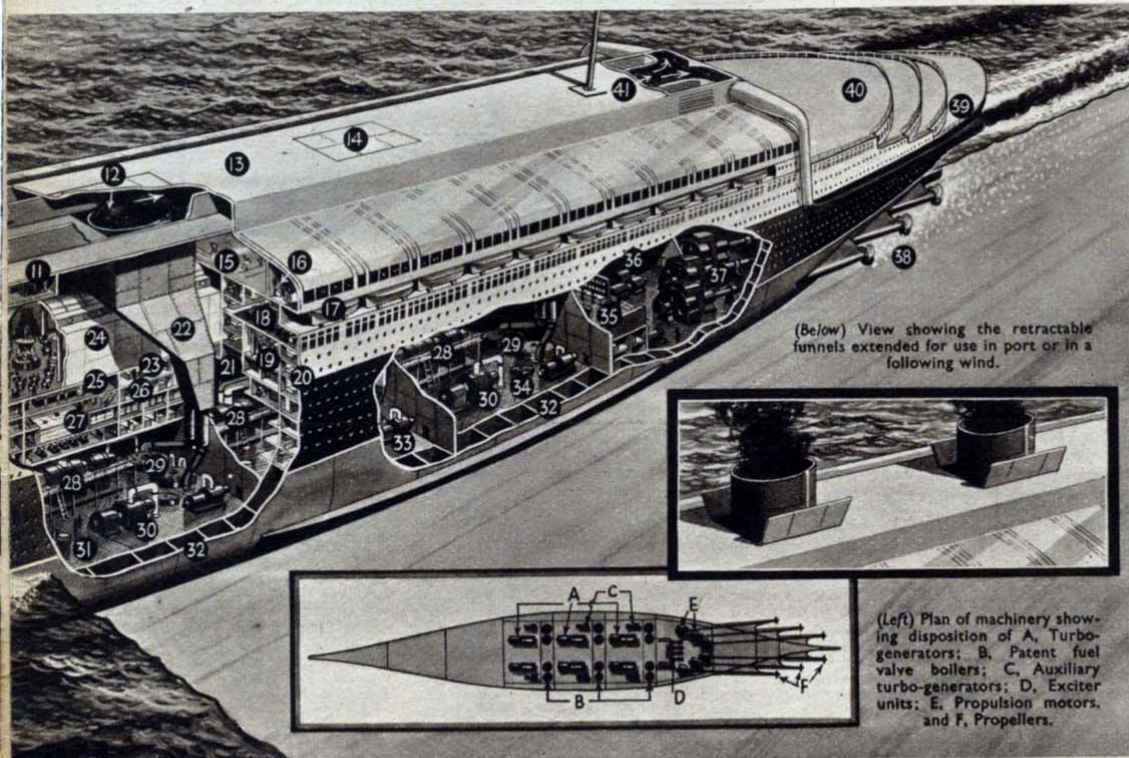
These ships don't pay their way. They never have. Their real use to a nation is that of prestige. At present the world seems to think that the nation running the biggest and best ships over the Atlantic has something the other nations haven't got.

And, according to international observers, the prestige value is big. So a government would pay for it.

But even at that, for the price of one of these ships a big fleet of a hundred passenger flying boats that would show a profit over the route could be constructed.

Hardie and Malglaive have one big grumble to offer with their design. They say that it is of little use building ships like this and sailing them to the limit from quay to quay while the irksome customs and immigration rules now in force hold good.

A ship can cut precious hours off a transatlantic voyage, only to have them all wasted on the quayside by drawn-out customs examinations, passport examinations and slow railway train communications.



(Below) View showing the retractable funnels extended for use in port or in a following wind.

(Left) Plan of machinery showing disposition of A, Turbo-generators; B, Patent fuel valve boilers; C, Auxiliary turbo-generators; D, Exciter units; E, Propulsion motors; and F, Propellers.

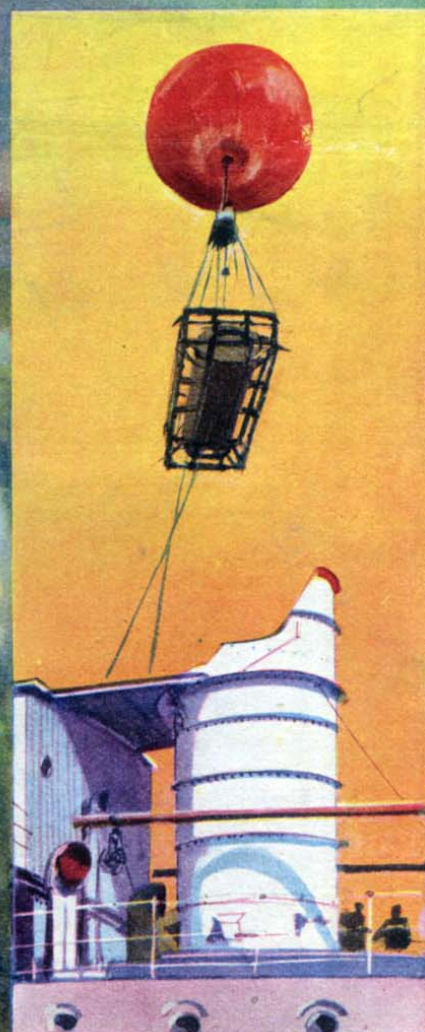
EVERY WEDNESDAY

TWOPENCE

Modern Wonder



RAYAN DE GRUBB

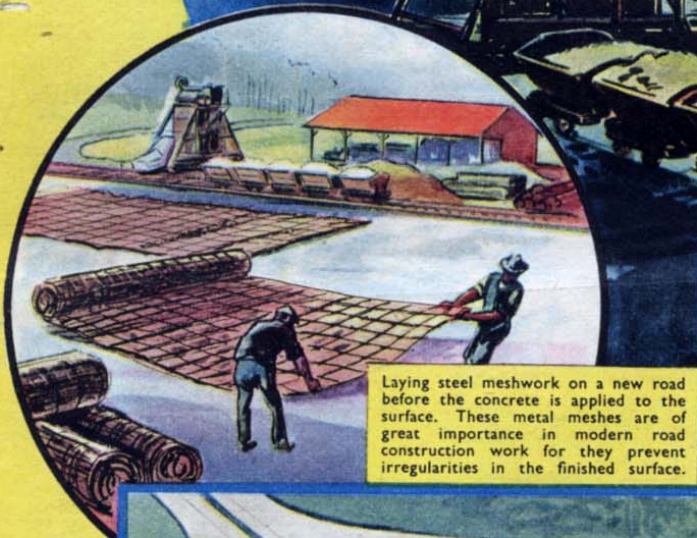


In This Issue: WEATHER STATION 12 MILES UP • TOO SCARED TO COLLECT GOLD • AIRLINES OF THE WORLD

A SOUNDING balloon ascending from the former convict ship *Carimare*, now used as a floating meteorological station. The funnel has been cut away to form a launching tube 15 feet by 9 feet for the balloons, the gondolas of which carry a barometer, hygrometer, and wireless transmitter. Full story on page 12 of this issue.

MODERN HIGHWAY CONSTRUCTION

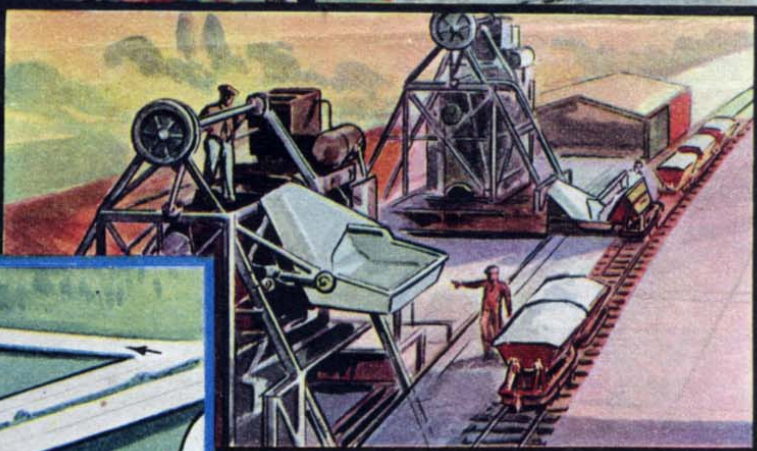
ON the right is shown a night scene with work in full swing on a modern road in Germany. Under the concentrated glare of powerful arc lights, the latest type of road-finishing machine is in operation. This machine, which is moved into position on special rails, pounds and smooths the concrete on the bed of the road. Oscillating at the very high rate of 4,000 blows a minute, it compacts the concrete, at the same time expelling all the superfluous moisture that would impair the binding qualities of the material. Not only does this giant machine pound the concrete, it also smooths the surface before moving forward to a new sector.



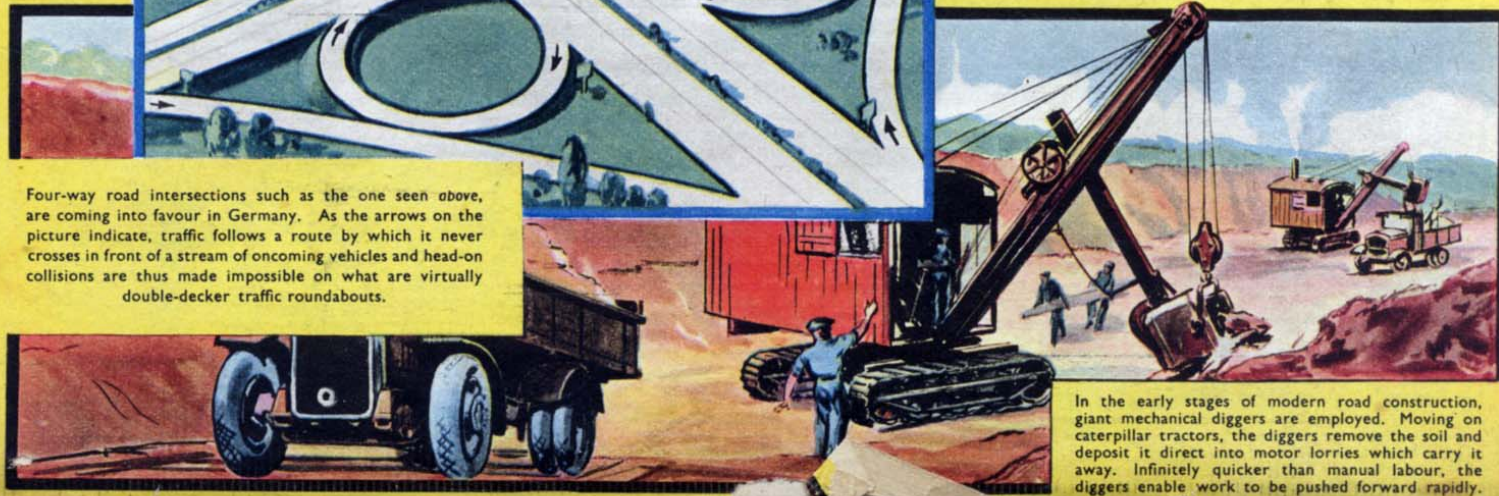
Laying steel meshwork on a new road before the concrete is applied to the surface. These metal meshes are of great importance in modern road construction work for they prevent irregularities in the finished surface.



Four-way road intersections such as the one seen above, are coming into favour in Germany. As the arrows on the picture indicate, traffic follows a route by which it never crosses in front of a stream of oncoming vehicles and head-on collisions are thus made impossible on what are virtually double-decker traffic roundabouts.

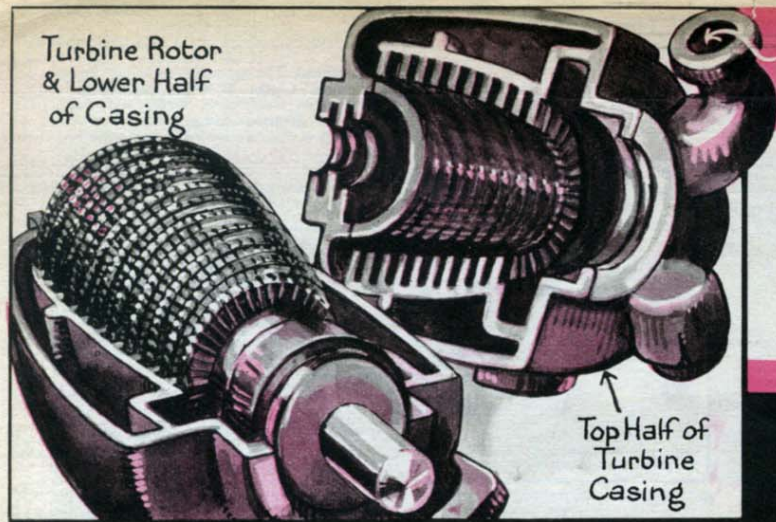


In modern road construction, it is customary for the verges to be completed before the work on the crown of the road is undertaken. When these verges have been constructed, rails are laid down on them and tip-trucks are employed to convey the cement and aggregate from the mixing machines similar to the one pictured above, to the section of road under construction.



In the early stages of modern road construction, giant mechanical diggers are employed. Moving on caterpillar tractors, the diggers remove the soil and deposit it direct into motor lorries which carry it away. Infinitely quicker than manual labour, the diggers enable work to be pushed forward rapidly.

Turbine Rotor
& Lower Half
of Casing



Steam
Entry

Top Half of
Turbine
Casing

STEAM LOCOMOTIVE WATERLESS

THERE are many places in the world where rigorous conditions are in force, in many ways unsuitable to any form of transport, but where transport has to be maintained.

Such a place is found in the Argentine, in particular on the cross-country route of the State Railways between Tucuman and Santa Fé, four hundred and ninety-five miles of continuous work. Gradients are very severe, and full loads must be handled.

But that is not all. The steam locomotive demands ample supplies of good water, and one suitable for this sort of work requires at least forty-five gallons for every mile run.

The four hundred and ninety-five question mean about twenty-two gallons, say one hundred tons—far beyond the capacity of any tender to carry. There must be good water also, unless the locomotives are to be quickly derailed.

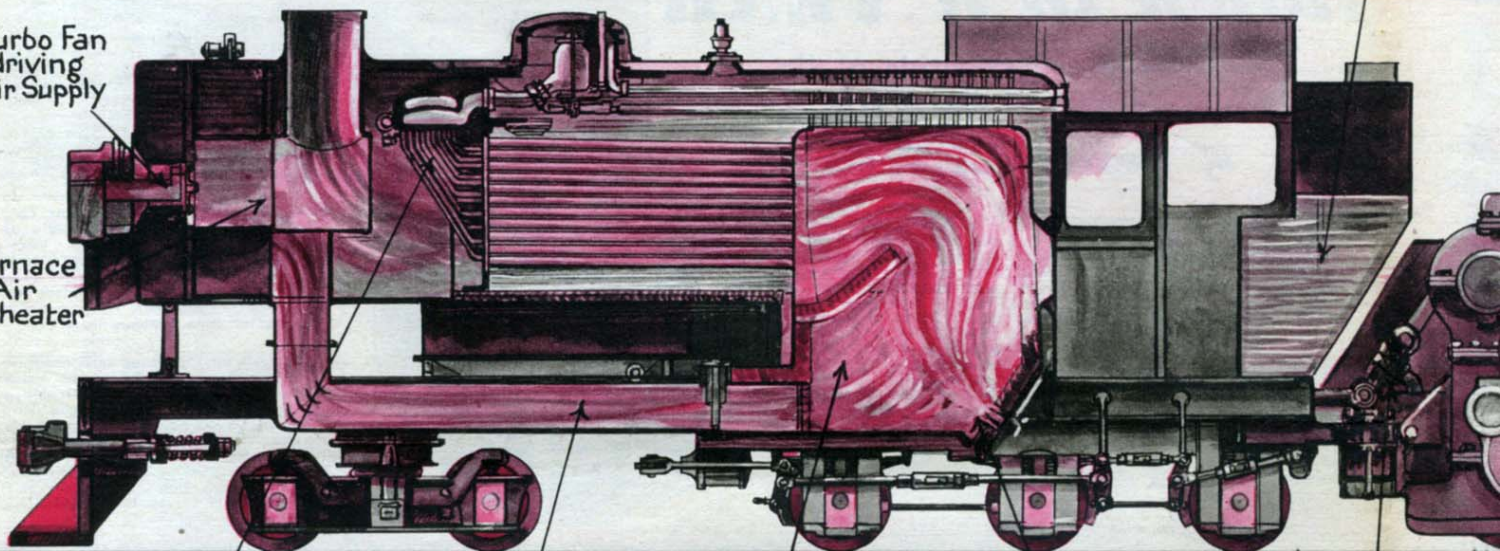
There is no such water available in quantities over this stretch of 1,000 miles. Actually there is one stretch of two and fifty miles where there is also water of any sort whatever to be had, a matter for a new type of locomotive that is what we have here.

The Ljungström Turbine Engine, the Swedish engineer Nydqvist fulfils all the requirements imposed by the conditions, and it departs from the normal in being a

Fuel Oil
Bunker

Turbo Fan
driving
Air Supply

Furnace
Air
Preheater



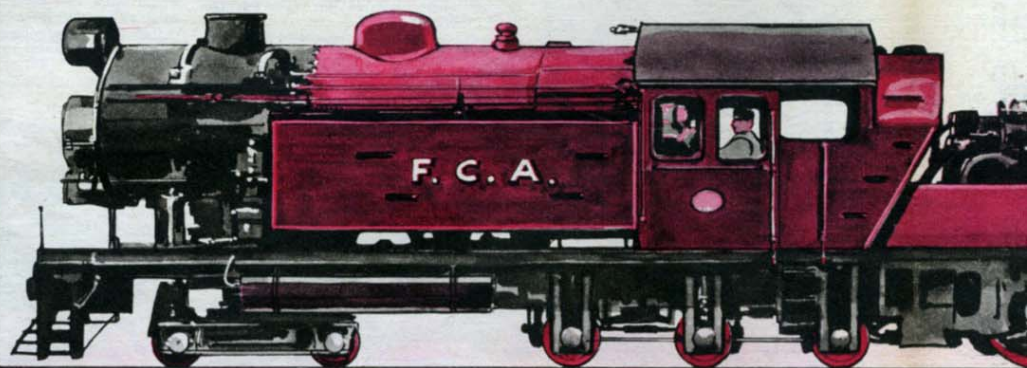
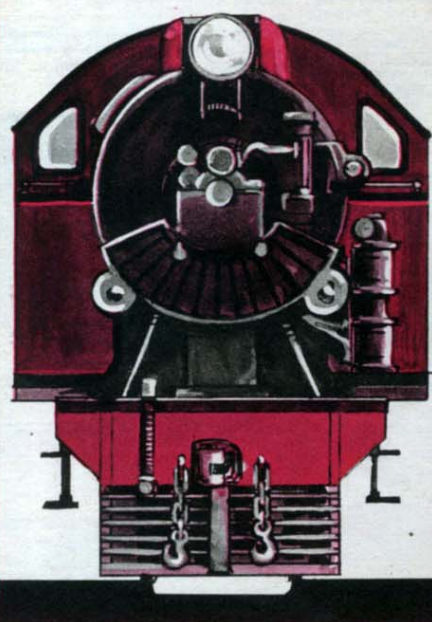
Steam
Superheater

Furnace Air
Supply Duct

Oil-Fired
Furnace

Oil
Burners

Steam Pipe
to Main
Turbine



this draught, it is necessary to provide a blower to supply the essential air for fuel consumption. At the front of the smokebox (see also the sketch, bottom left) is a turbine-driven fan. This draws air through a set of louvers, the opening of which is controllable, passes it through a pre-heater, and thence to the firebox by way of a large pipe.

Some of the entering air turns up the chimney to aid the draught at that end.

Beyond these features the leading vehicle has no other points of particular interest.

On the right is the driving and condenser car, full of interesting details. Steam is led by way of a jointed pipe to the turbine, developing about one thousand seven hundred and fifty horse-power, also shown with the top half of the casing removed (top left).

Turbines always run at high speed, and this one runs at ten thousand revolutions to

turn out maximum power, far beyond the speed of any driving wheels. So it has reduced by means of a gearbox, with stages of reduction, to a matter of a hundred and nine revolutions a minute driving axle. The gearwheels are of the tooth type favoured by marine engineers. An idle pinion is provided, just as in a motor car gearbox, for reversing, with safeguards to prevent steam being put

LOCOMOTIVE FOR LESS DESERTS

... hundred and ninety-five miles in mean about twenty-two thousand say one hundred tons—far beyond the of any tender to carry. This water good water also, unless the boilers of motives are to be quickly destroyed.

... is no such water available in large as over this stretch of line, and there is one stretch of two hundred y miles where there is absolutely no any sort whatever to be had. Clearly r for a new type of locomotive and what we have here.

a turbine, but the fact that it condenses a large part of its exhaust steam into feed water for the boiler makes it a revolutionary design.

It is thus able to make the run with a full load—possibly up to one thousand seven hundred tons—at an average speed, including frequent stops, of twenty-two miles an hour, consuming no more than one thousand four hundred gallons of water.

Below is a sectional drawing of the complete machine. The leading vehicle carries the steam generating plant, fuel oil bunker and tanks with a reserve supply of water. Normal design is employed and the steam pressure is 280 lbs. to the square inch.

There being no exhaust steam to turn into the chimney to make a blast for maintaining

Heated Air discharged by Fans

Air drawn between Pipes by Fans

Fuel Oil Bunker

Turbine driving Cooling Fans

Cooling Fans

Fan-Driving Shafts

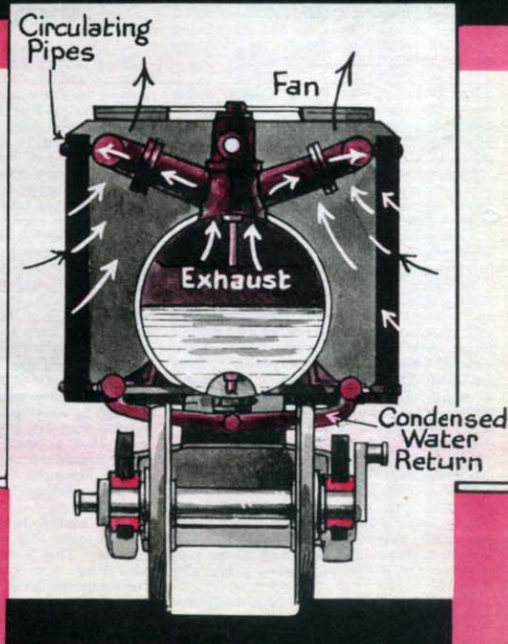
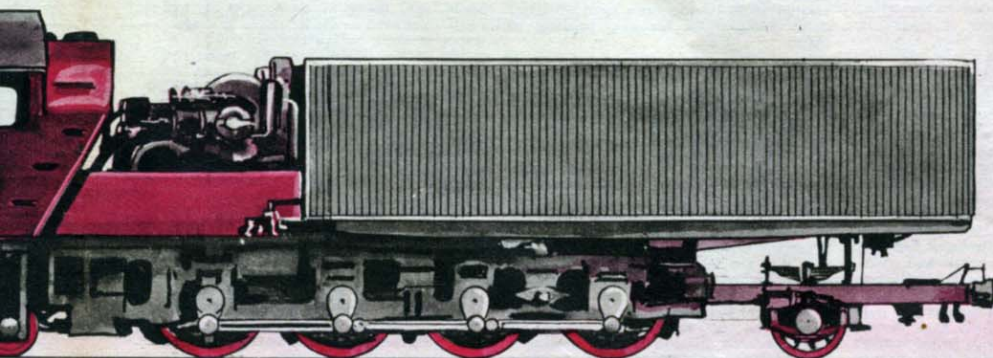
Steam Pipe to Main Turbine

Reduction Gear Box

Main Turbine

Eight-Coupled Driving Wheels

Surface Condenser Water



maximum power, far beyond the any driving wheels. So it has to be y means of a gearbox, with three reduction, to a matter of three and nine revolutions a minute at the le. The gearwheels are of the helical e favoured by marine engineers. pinion is provided, just as with the gearbox, for reversing, with elaborate to prevent steam being put on to

the turbine until one gear or the other is perfectly in mesh. Drive from the leading axle is passed on to the remaining wheels by coupling rods in the usual way. The exhaust steam from the turbine passes straight into the cylindrical drum, seen also in cross section in the sketch (bottom right). This contains water, and contact with this condenses some of the steam. The remainder passes upwards and out by way of the four

pipes, each of which branches out on either side to long header pipes. These connect with similar pipes at the bottom by means of hundreds of flattened tubes, between which large volumes of air are drawn by four large fans. These fans, which can be seen in the view of the condenser car top (top right), are gear-driven by a third turbine. The condensed steam, now hot water, drains into the sump pipe and is pumped back to the boiler.

WHAT would this world of ours look like from 20,000 miles out in space? Here's a building to supply the answer

by changing his or her position, can see the earth passing through its various phases in the same manner as we see the moon from the earth, with the exceptions that the earth will appear much larger and will revolve so that all parts of its surface will be seen passing through these phases.

The globe representing the earth will be twenty feet in diameter and will be executed in true colours and relief, and will show all the details that would be visible to us were we out twenty thousand miles in space. When viewing the earth from the look-out windows the spectators would at first see only the great masses of the oceans and continents; but looking through binoculars which would be available at these points, the great rivers, mountains, lakes, and forests would be clearly defined.

The scale of this globe is thirty-two miles to the inch, making it possible to see the larger works of man on this earth. The large cities would be recognized on this globe with the naked eye as a spot of grey, while with the binoculars even smaller cities would be visible. Manhattan Island in New York City will appear about half-an-inch long and one-sixth of an inch wide and will be visible with the aid of binoculars.

The cost of the cosmosarium is estimated at approximately £200,000, exclusive of the cost of land. The value of the institution—land for such a use would be made available by any large city where the cosmosarium is built.

The usual planetarium has been found to be self-sustaining. And since the cosmosarium with the view of the earth in space would have an even greater appeal to all, it would be found that if a nominal charge (such as is usual at a planetarium) were made, the cosmosarium would not only prove self-sustaining but would show a small return on the invested capital.

In this connection it should be noted that while a very limited number of persons can be accommodated at the performances of the planetarium an almost unlimited number of visitors can be accommodated comfortably and without confusion in the cosmosarium. If the cosmosarium is located in a large city, the annual income may be conservatively estimated at £60,000, which would net a small return on the investment after deducting the running charges.

The WORLD in SPACE



Above (left) you see what the exterior of the cosmosarium will look like when it is finished, and above is how the earth appears in space. This model is to the scale of thirty-two miles to the inch.

into space but none of these gives even a slight promise of succeeding.

The cosmosarium as conceived and designed by Peter J. Bittermann, Jr., Architect, of 101, Park Avenue, New York, will make it possible for all of us to enjoy a very realistic view of the earth in space.

As the cosmosarium is an entirely new conception, it is advisable to compare it with the only familiarly known and related form—the planetarium.

Many of us are already familiar with the planetarium, and though the spectacle presented by the planetarium thrills us, we all realize that it leaves this one wish—to see the world upon which we live in its proper place in the universe—unsatisfied.

The cosmosarium, on the other hand, satisfies this universal wish, for it differs from a planetarium in that while in a planetarium the spectator sees the skies as they appear to us from the earth, the cosmosarium presents the spectacle of the earth suspended in space against the background of stars and planets.

This then would be the true picture of the earth as it would appear to us if we were really projected out into space to a distance of twenty thousand miles or about one-twelfth the distance to the moon. A visit to the cosmosarium would offer us an experience that would be as complete as a trip to the moon.

The cosmosarium as illustrated in the accompanying photographs and drawings consists of a circular base of masonry, housing within its enclosure exhibition halls, the entrance hall, cloak rooms, etc. Out of this base rises three buttresses sixty-four feet high. Upon the outer faces of these great buttresses will be mosaic figures in bas-relief, symbolic of the three elements fire, air, and water.

These buttresses support a tall spherical dome one hundred and twenty-eight feet in diameter. This spherical dome will be of concrete covered on the outer surface with vitreous tiles of a dark blue colour and upon which will be traced in gold figures symbolic of the principal constellations.

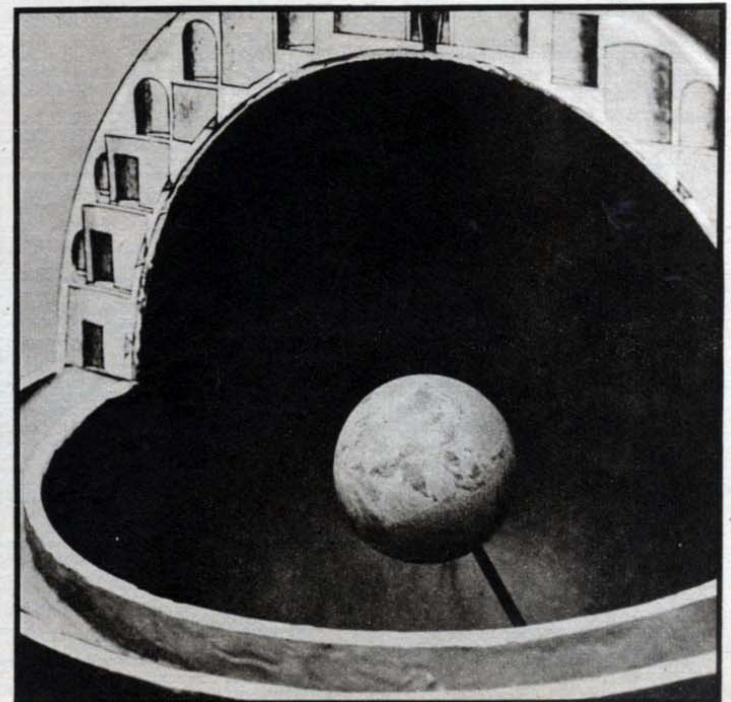
Elevators and escalators in the three buttresses and connected with the two spiralling ramps will enable visitors to reach the upper part of the cosmosarium quickly.

From many vantage points along the spiralling ramps and from lounges provided at various points along these lines visitors can peer through the look-out windows to behold the earth in space. As

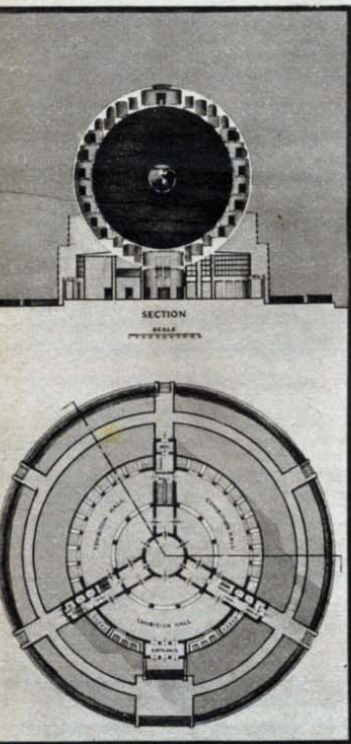
these observation points or look-out windows are placed at many spots, it will be possible for the visitors to see the earth from any elevation and always revolving in space with its starlit background.

The illusion of space will be presented by means of the inside of the smaller sphere, one hundred feet in diameter, which will be entirely dark in its interior except for the stars and planets which as bright jewels will stud the inner surface in a true representation of space.

In the very centre of this dark sphere representing space a globe representing the earth will be suspended and will revolve upon its axis. As the light of the sun will reach the earth from a fixed point and as the earth revolves, the visitor,



And here is a view of the cosmosarium from the rear. Part of the dome has been removed so that you can see how the globe representing the earth is suspended in the centre.



The architect's scale plan showing in complete detail the arrangement for the new cosmosarium. In the upper picture is seen the exterior with the rounded dome removed to show the world in space, and in the lower are details of the interior.

MEN of science as well as poets and artists have often told of the wonderful spectacle that would present itself to us if we could but project ourselves out into space and look back upon the earth and see it in its proper place in the universe.

Of course the pictures which they created were entirely the product of their imaginations as no one has until now found a means for accomplishing the feat. Rockets of various kinds have been designed for projecting a person

EVERY WEDNESDAY

TWOPENCE

Modern Wonder

Cutting a Continent in Two

Where once was fever-infested swamp, the Panama Canal cuts its way from coast to coast, linking up the Atlantic and Pacific Oceans. £94,000,000 went to the construction of the Canal through which great ships now pass. Excepting over the nine-mile stretch of the Culebra Cut they can travel at full speed

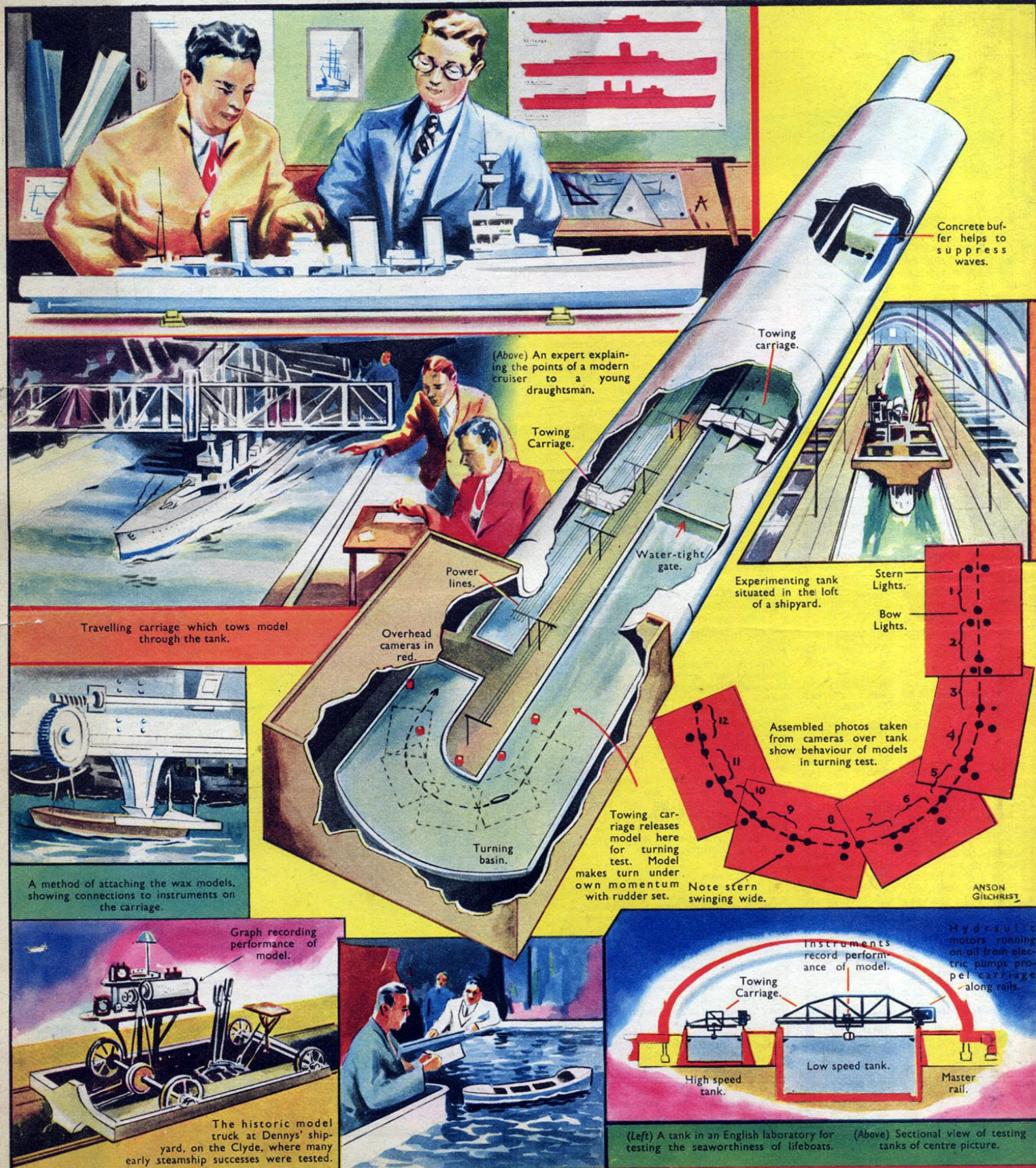


Franklin Parker

digging
workers fill
tons of rock
solidified the

SCHOOL FOR ATLANTIC FLYERS • COLOUR TELEVISION •
ORDS ARE NOT FINISHED • MARVEL OF NEWS BY WIRE

TESTING MODELS OF MEN-O'-WAR



WHEN naval architects have completed their plans for a new ship, a scale model is constructed for testing such important features as drag or resistance to passage through the water, stability in rough seas, and other important points. These tests are carried out in specially designed tanks and are of a most exacting nature. Both high-speed and low-speed tests are made, the

model being drawn through the water in the tank by means of a towing carriage that can travel at speeds ranging from 10 to 30 knots, and some of the most recent test tanks measure as much as 1,600 feet in the section devoted to high-speed trials. The towing carriages are most intricate apparatus and enable the speed at which the model travels to be checked with perfect accuracy.

Special cameras are employed to record the behaviour of self-illuminated models, and by these means the designers can follow the ship's reactions to the varying conditions to which she is subjected. Such attention to detail does a very great deal to ensure that when the vessel is finally built she will be capable of giving of her best under all conditions.

It's COLOUR Television NOW

One of the most remarkable developments in Television is described clearly for you in this interesting article

SCIENTISTS are dour fighters. The sterner the battle, the harder do they strive to win through, for "impossible" is a word which has no meaning for them. When you make it your job to turn dreams into realities, there is no room for lack of faith or enthusiasm if you mean to achieve what appears to be the impossible.

For instance, the pioneers in the realms of television research soon found themselves confronted with what must at first have seemed to be an almost insurmountable barrier. Briefly expressed, it was this—whereas in telephony it is not necessary to resolve the current used into separate parts, and then reproduce each of those parts separately, in television light value can be transmitted in no other way.

However, obstacles are made to be overcome, and for years the scientists tested, probed and experimented until they finally triumphed. They succeeded in co-ordinating light impulses into pictures by a method known as "scanning," and thus man was able to make another "impossibility" a reality and send moving pictures over the air.

Scanning, as you remember if you read the interesting article on television that appeared in No. 16 of MODERN WONDER, is the process by which a picture is divided up into myriads of fine lines. The detail of each of these lines is dictated by a special apparatus that regulates their strength or faintness, so that the receiver can transcribe them correctly at the end of their flight through space in the form of impulses.

Having achieved so much, you might well excuse the scientists if they sat back with a sigh of content, crossed their hands and said in effect: "There! Look at the wonders we have performed. Aren't we clever fellows?" But that's not the way of scientists.

Having done so much, they promptly got busy seeking new worlds to conquer, and the particular new world on which television experts turned their eye was

A compact and efficient television camera being used to record an open-air sporting event. The problems confronting the experts are being solved one by one, and in the not far distant future television may become as general as radio.

Colour. And already they have advanced far towards their goal.

The latest developments in colour television are discussed by Mr. J. H. Reyner, B.Sc., A.C.G.I., A.M.I.E.E., M.Inst.R.E., in the second edition of his book, *Television Theory and Practice* (Chapman & Hall, 12/6 net), and a very interesting book it is.

Clearly and comprehensively written, and illustrated with diagrams and pictures that cannot fail to help the reader enormously, Mr. Reyner's book is of very real value to all who are interested in the principles of television and their practical application.

Now, the problem of applying true colour to television is a mighty tricky one, as the author explains. As long ago as 1928, successful experiments in colour television were made both in this country and in America, and these experiments are still going on, despite the many set-backs and only partial successes that have been the lot of the scientists.

One of the main points the television experts have to bear in mind is this—the human eye is more sensitive to some wave-lengths of light rays than to others, and therefore they have to use their colour in such a way that it will react on the eye to the best possible effect. Before we go on to examine the methods by which they manage to do this, it is worth while noting how thorough are the investigations of our modern scientists.

Mention was made just now of wave-lengths. These are estimated, not in terms of feet or inches, but in units of a millionth of a millimetre—it is written with an ordinary letter "m" followed by a Greek "mu," or "mu," by the way—and a millimetre itself is only 0.03937 of one of our own inches.

Now, it has been found that the human eye is most sensitive to a light ray that has a wave-length of 530 millionth of a millimetre, and this produces a sensation of green. If a slightly longer wave-length is used, the green becomes tinged with yellow, and ordinary white light is made up of colour ranging from deep violet to dark red.

Thus, by faking such primary colours as red, yellow-green and blue and mixing them together carefully, it is possible to get any colour or blend of colours that are to be found in the spectrum.

The simplest way to get this colour



effect in television is by what is known as the triple scanning system. Only one disc is used for this triple scanning, and this is provided with three spirals that are arranged on its face in the manner shown below. These three sets of holes are covered with filters, one of red, one of blue and the third of green, and impulses that correspond to primary colours of the television subject are transmitted.

A similar triple disc is used at the receiving end, and thus the subject is really scanned three times—once for each of the colours—and the picture at the receiving end is built up three times over.

You might naturally suppose that when the scanning has to be done three times instead of once, the process would have to be carried out three times as fast, but not a bit of it. It is the human eye that will be viewing the picture, and it never takes in colour as quickly as it does ordinary light. So, thanks to one of Dame Nature's little peculiarities, all that is necessary in colour television is a slight speeding up of the rate of scanning.

One of the great essentials for successful

lamp that contains a mercury-helium vapour combination.

This latter is used to make up the green and blue colours, and a commutator arrangement at the receiving end switches on the neon lamp at the moments when the red filter holes are revolving past that particular light source.

A great advantage that this particular type of scanning possesses is that only one disc is used instead of three separate channels of communication for the red, blue and green.

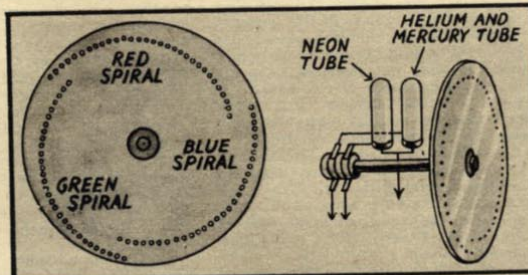
If you visit a television studio when a programme is being transmitted, one of the first things that will strike you is the extraordinary appearance of the artistes taking part. Their faces and hands will probably have a weird "greenery-yallery" colour that is anything but becoming.

This bilious look is not the result of stage-fright—the performers are far too experienced for such unfortunate reactions—it is caused by the distinctive make-up they have to use. Mr. Reyner explains the reason for them having to spoil their natural beauty in this way, and once again it is because of the funny reactions of the human eye to different colours.

You might well think that, although this strange make-up is essential for performers who take part in programmes when the ordinary monochrome television transmission is used, it would not be necessary when colour was being employed. But you would be wrong. Experiments have satisfied the experts that colour makes no difference at all in this respect.

Our eyes, in fact, are not uniformly colour-sensitive, which means that although they react only slightly to colours such as red and violet, which come at the end of the spectrum, and not at all to ultra-violet rays, they pick up yellow-green lights very quickly. Thus, in order to overcome the difference that exists between the colour sensitivity of the human eye and the optical links in a television system, it is essential to emphasize those colours that react the most favourably.

There are other methods employed to produce colour in television, notably the cathode ray system, which operates on much the same lines as do colour cinema films. Mr. Reyner believes that this method may be more and more generally adopted, but whether you prefer your television "penny plain" or "twopence coloured," you will find his book helpful in mastering the mysteries of the subject.



On the right are the type of triple disc used for colour television, and next to it is a receiving apparatus such as is often used when colour is employed. The neon tube provides the red rays and the mercury-helium tube the green and blue.

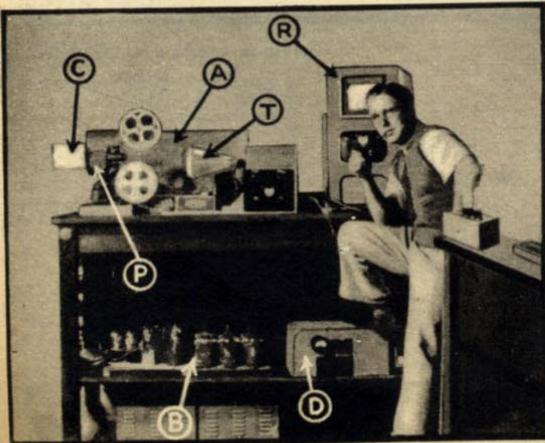
A photograph from Mr. J. H. Reyner's book and showing him with an early film transmitter. The light on transmitter tube T is focused on film in projector P. The photo cell C analyses light intensity and feeds vision amplifier A which supplies receiver R. A common time base B provides scan for transmitter and receiver tubes and power supply D delivers 6,000 volts to transmitter and 3,000 volts to receiver.

colour transmission is that the light used is as nearly white as possible. It is an easy matter to arrange this at the transmitter, but when it comes to doing the same at the receiver, snags crop up at once. And the reason is because a light must be used that can be modulated by the signals received, and such a light is by no means easy to procure.

For instance, a neon light would be quite useless because its red colour would prevent it giving any light through the blue and green discs. And, of course, these two discs must play their fair share if a picture is going to be built up correctly as far as the colour qualities are concerned.

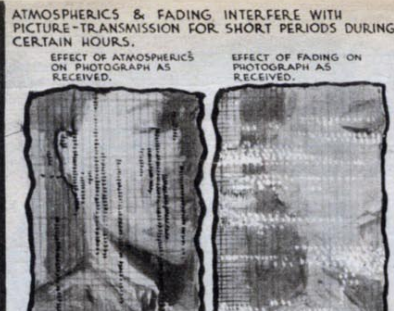
The Baird television experts have been experimenting for some time on rather different lines. Instead of employing only one light source, they have two, each of which is used only when certain colours or combination of colours are required.

One of these light sources is an ordinary neon lamp which is used to provide the red rays, and the other is a





THE BEAM WIRELESS STATION AT SOMERTON, SOMERSET, WHERE THE PICTURES, IN THE FORM OF ELECTRICAL IMPULSES, ARE RECEIVED.



ATMOSPHERICS & FADING INTERFERE WITH PICTURE-TRANSMISSION FOR SHORT PERIODS DURING CERTAIN HOURS.

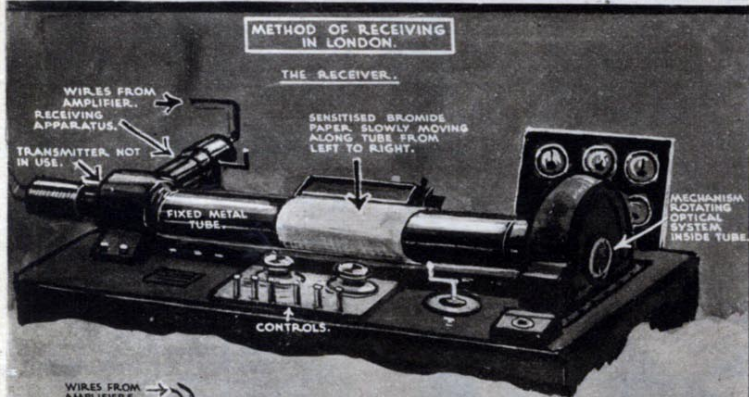
EFFECT OF ATMOSPHERICS ON PHOTOGRAPH AS RECEIVED.

EFFECT OF FADING ON PHOTOGRAPH AS RECEIVED.



AT THE TRANSMITTING & RECEIVING ENDS THE APPARATUS IS SIMILAR IN APPEARANCE; BUT DURING THE OPERATION OF RECEIVING THE WORK IS CARRIED OUT IN A DARK ROOM AS HERE SHOWN.

OPERATING CABINET. TRANSMITTING & RECEIVING AMPLIFIERS. RED LAMP. SYNCHRONISING APPARATUS.



METHOD OF RECEIVING IN LONDON.

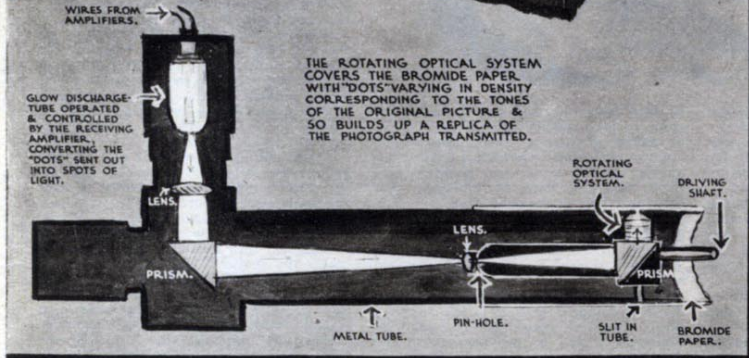
THE RECEIVER.

SENSITISED BROMIDE PAPER SLOWLY MOVING ALONG TUBE FROM LEFT TO RIGHT.

WIRES FROM AMPLIFIER. RECEIVING APPARATUS. TRANSMITTER NOT IN USE.

MECHANISM ROTATING OPTICAL SYSTEM INSIDE TUBE.

CONTROLS.



THE ROTATING OPTICAL SYSTEM COVERS THE BROMIDE PAPER WITH "DOTS" VARYING IN DENSITY CORRESPONDING TO THE TONES OF THE ORIGINAL PICTURE & SO BUILDS UP A REPLICA OF THE PHOTOGRAPH TRANSMITTED.

WIRES FROM AMPLIFIERS.

GLOW DISCHARGE TUBE OPERATED & CONTROLLED BY THE RECEIVING AMPLIFIER, CONVERTING THE "DOTS" SENT OUT INTO SPOTS OF LIGHT.

ROTATING OPTICAL SYSTEM.

DRIVING SHAFT.

PRISM.

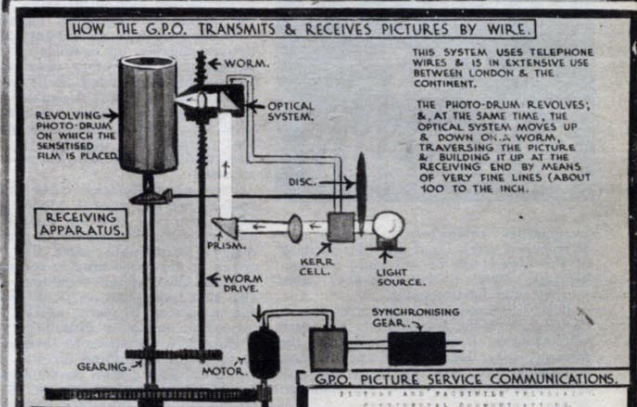
LENS.

PIN-HOLE.

SLOT IN TUBE.

BROMIDE PAPER.

TWO CINEMATOGRAPH PICTURES OF SCOTT & BLACK AS RECEIVED FROM AUSTRALIA BY BEAM RADIO. TRANSMITTED PICTURES OF SCOTT & BLACK ASSEMBLED AS A CINÉ FILM.



HOW THE G.P.O. TRANSMITS & RECEIVES PICTURES BY WIRE.

THIS SYSTEM USES TELEPHONE WIRES & IS IN EXTENSIVE USE BETWEEN LONDON & THE CONTINENT.

THE PHOTO-DRUM REVOLVES, & AT THE SAME TIME, THE OPTICAL SYSTEM MOVES UP & DOWN ON A WORM, TRAVERSING THE PICTURE & BUILDING IT UP AT THE RECEIVING END BY MEANS OF VERY FINE LINES (ABOUT 100 TO THE INCH).

REVOLVING PHOTO-DRUM ON WHICH THE TRANSMITTED FILM IS PLACED.

RECEIVING APPARATUS.

PRISM.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.

OPTICAL SYSTEM.

DISC.

PRISM.

KERR CELL.

LIGHT SOURCE.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.

OPTICAL SYSTEM.

DISC.

PRISM.

KERR CELL.

LIGHT SOURCE.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.



PLACING A PHOTOGRAPH & CYLINDER IN THE TRANSMITTING APPARATUS.



G.P.O. PICTURE SERVICE COMMUNICATIONS.

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

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CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34

CYRILLICAL SOUND RECORD

21-11-34 AND 21-12-34



"PHASING" HANDLE.

SYNCHRONISING HANDLE.



NORTH POLAR REGIONS.

BRITISH ISLES.

EUROPE.

AFRICA.

ARABIA.

INDIA.

CINÉ FILM.

RECEIVING APPARATUS.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.

OPTICAL SYSTEM.

DISC.

PRISM.

KERR CELL.

LIGHT SOURCE.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.

OPTICAL SYSTEM.

DISC.

PRISM.

KERR CELL.

LIGHT SOURCE.

WORM DRIVE.

GEARING.

MOTOR.

SYNCHRONISING GEAR.

WORM.

Reproduced by courtesy of Illustrated London News

"SPEED" is the modern watchword, but even its most ardent advocates cannot cavil at a speed which enables news pictures and ciné pictures to be received in England twenty-five minutes after leaving Australia. Thanks to beam radio, ciné films as well as facsimile pictures can

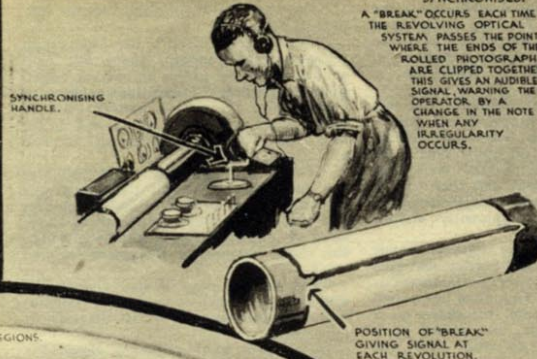
be sent half round the world by this means. When ciné photographs are to be sent by radio, they are first enlarged for transmission from Melbourne, and on arrival in London are reduced to their original size for use in ordinary projectors. The picture to be radioed is curled round a

fixed metal tube which is divided by a fine slot into two equal lengths and is attached to a carriage which moves slowly along the fixed tube. As each portion of the picture comes over the slot, a spot of light from the optical system rotating inside the tube is focused on the picture.

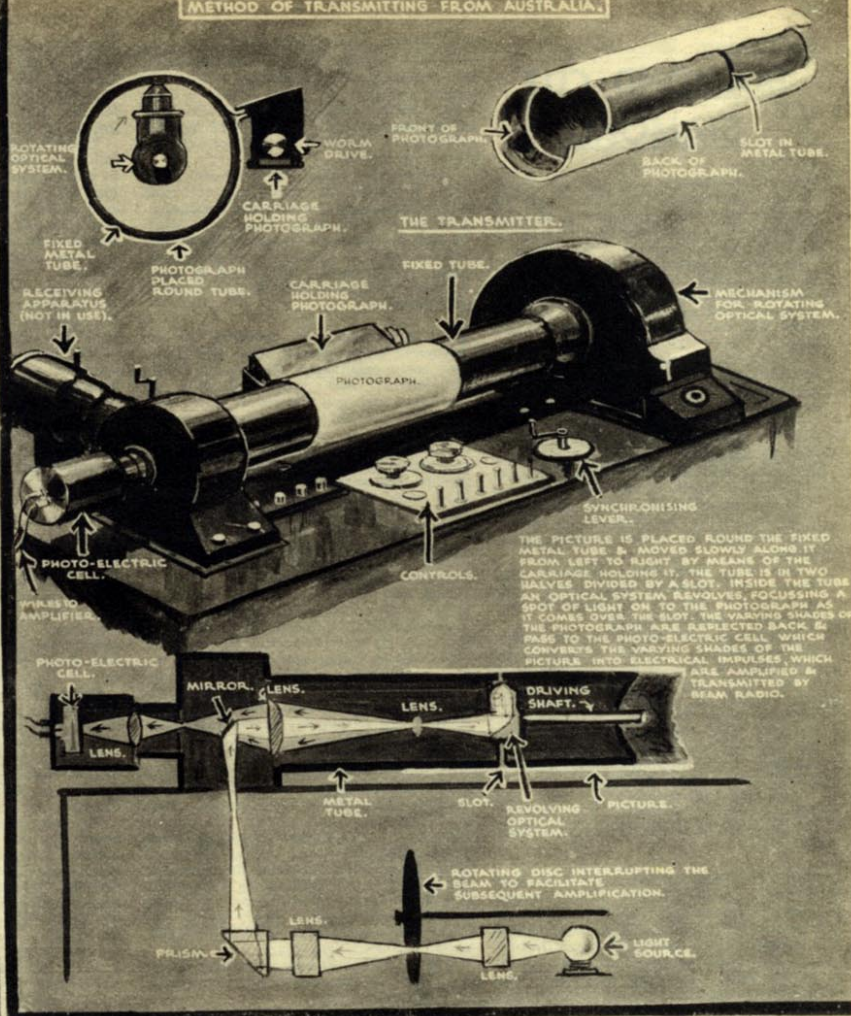
Similar apparatus is used at both transmitting and receiving stations, and this consists of an operating cabinet, amplifiers and the synchronising plant. When the little dots of light, which record the tone values of the picture are reflected from the optical system, a series

of prisms pass cell. They are electrical impulses and these impulses to the beam from which the Aerials at the signals at the

"PHASING" TO KEEP TRANSMITTING & RECEIVING INSTRUMENTS SYNCHRONISED.



METHOD OF TRANSMITTING FROM AUSTRALIA.



CIRCULAR ROUTE OVER WHICH THE PICTURES ARE TRANSMITTED FROM AUSTRALIA TO ENGLAND - FROM NOON TO MIDNIGHT (GREENWICH MEAN TIME)

INDIA.

BORNEO.

AUSTRALIA.

MELBOURNE.

THE CIRCULAR ROUTE OVER WHICH PICTURES ARE TRANSMITTED FROM AUSTRALIA TO ENGLAND FROM MIDNIGHT TO NOON. (GREENWICH MEAN TIME)

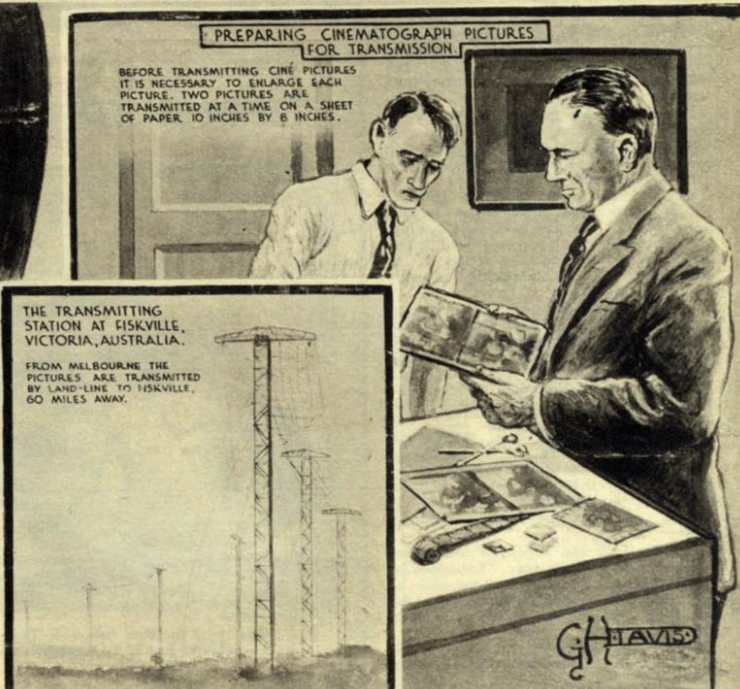


PREPARING CINEMATOGRAPH PICTURES FOR TRANSMISSION

BEFORE TRANSMITTING CINÉ PICTURES IT IS NECESSARY TO ENLARGE EACH PICTURE. TWO PICTURES ARE TRANSMITTED AT A TIME ON A SHEET OF PAPER, 10 INCHES BY 8 INCHES.

THE TRANSMITTING STATION AT RISKVILLE, VICTORIA, AUSTRALIA.

FROM MELBOURNE THE PICTURES ARE TRANSMITTED BY LAND-LINE TO RISKVILLE, 60 MILES AWAY.



of prisms pass them to a photo-electric cell. They are then converted into electrical impulses of varying intensity, and these impulses are sent by land-line to the beam radio transmitting aerials, from which they are flashed into space. Aerials at Somerton intercept these signals at the receiving end and send

them by land-line to London where the picture-receiving apparatus, which, like the transmitting apparatus also shown above is made by Marconi's Wireless Telegraph Co., transforms the impulses into pictures. This is carried out in a room in which the only light is from a red lamp.

In this room, sensitized bromide paper is placed outside a metal tube on the receiving instrument in which a glow discharge-tube converts the impulses into varying shades of light, corresponding to the tone-shades of the picture. The "flickies" from this glow discharge-tube pass through a series of prisms and lenses

to the lens system rotating inside the tube. As the sensitized paper passes over the slit in the tube, the picture is built up as a facsimile of the photograph being transmitted from Australia. All that remains is for the bromide paper to be developed and then the picture is complete.

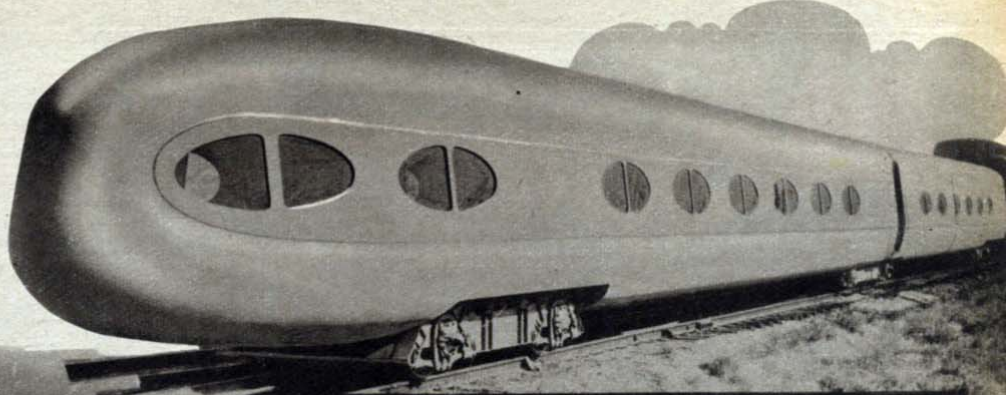
ALL COLOURS - OF THE FASCINATING STORY OF NAVIGATION

MODERN WONDER NEWSREEL

Nowadays we are always hearing the exhortation "get a move on," but there are all sorts of different ways of so doing. Take that queer object on the right for instance. It looks like the creature that swallowed Jonah, but it isn't; although American railway engineers certainly call it the whale of an idea. It's the latest in streamline coaches, and it is guaranteed to give smooth, easy running.



Here's more streamlining—a quarter of a mile of it—on the American railroads. The *City of Los Angeles* is the train's name and its three-car locomotive can exceed 110 m.p.h. going all out.

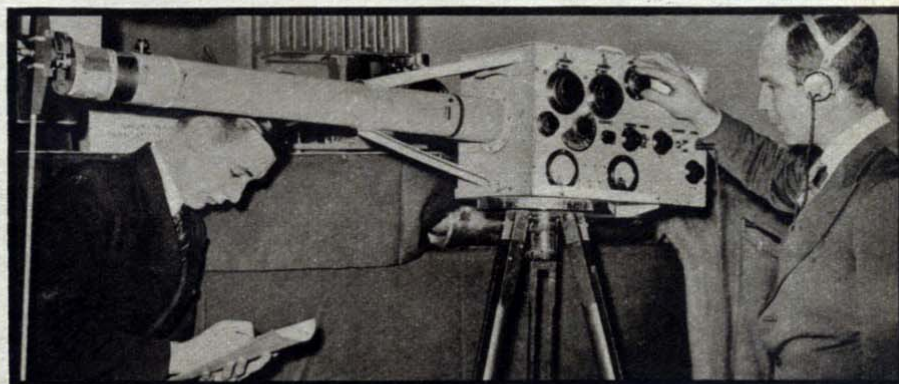
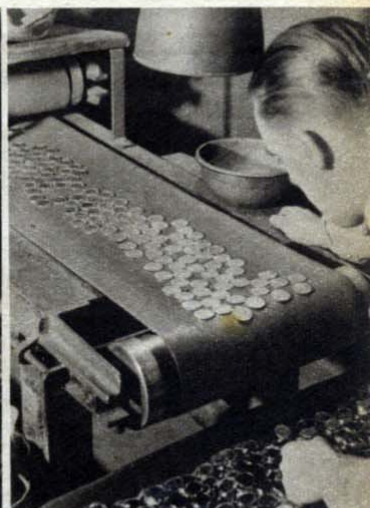
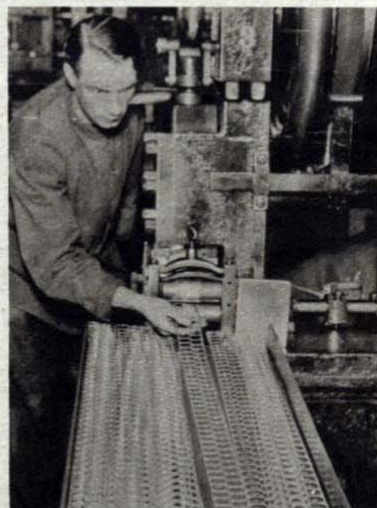


Before we leave America's railways take a look at the inside of this cab of a locomotive on the Pennsylvania Railway. The driver of the freight—goods train to you—is busy at the controls, while a radio operator talks to the conductor in the caboose—which, being translated, means the guard in the van. The big idea is that radio will do away with hand signals and lanterns in communication between ends of long trains.



Even dogs can get a move on at home nowadays, thanks to the contraption seen on the left. A sort of canine treadmill, it enables Fido to walk, trot, run and jump to his heart's content and a strap prevents him falling off in his excitement. Wet days won't mean muddy carpets any longer now.

Bob runs aren't confined to winter sports centres, and the nearer of the two pictures on the right shows one in the heart of the City of London—to be exact, at the Royal Mint. Actually, this is a two-bob run, for those long strips are of silver and are fed into the machine which cuts out the Imperial blanks ready to be pressed into florins. In the photograph next to it an expert is examining 1938 pennies on a running band before they are counted.



An all-round success is this huge spherical tank (seen on the left) that stands on the lake front at Cleveland, Ohio. For some years a bright flame had been shooting out of the ground to the puzzlement of passers-by who did not know that it was burning sewage gas. But now the tank catches the gas and saves it for use in burning garbage.

Well, what is it? A new type of telescope?—A super camera?—Something novel in range-finders? You're not even near it! As a matter of fact, it is a most ingenious device for measuring ultra short waves and its official designation is the Marconi Ultra Short Wave Field Strength Measuring Equipment and was on view at the annual exhibition of the Physical Society in London.



There is a good deal of work to be done from the time the men first get inside the wreck to the moment when it comes up to the surface. In the first place, it has to be divided off into compartments which are all sealed up so that air can be pumped into one and not into another.

The result of being able to pump more air into one section and less into others is that you can control the wreck when it begins to rise and thus bring it up on an even keel.

It also means you can keep it on the bottom till you are ready to bring it up. You can push the water out of the section where men are working, but allow it to fill all the others, so that there is no tendency for the wreck to rise.

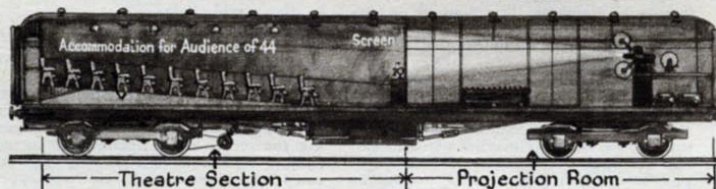
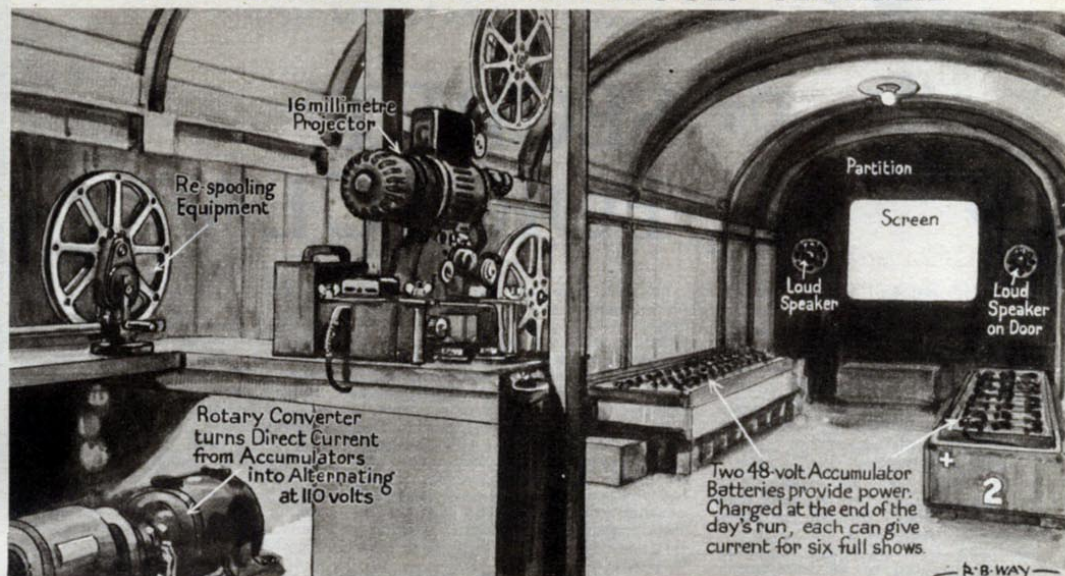
There was an occasion early one morning when a weak pipe which had passed unnoticed burst and allowed air from one section to rush into another.

The result was that the wreck shot to the surface, but it sank almost immediately and was raised later.

Another danger the workers in the wreck have to face is that of encountering gases and bad air. They are working with oxy-acetylene cutting torches, and in the presence of dangerous gases these may well cause an explosion such as has already happened on two occasions.

On one of them, three men were entombed and the salvage manager, Mr. T. Mackenzie, was blown right out through

THE SIXTY-MILE-AN-HOUR CINEMA



The enterprise of the London and North Eastern Railway and the celebrated firm Pathe, has provided travellers on that railway with a news theatre on wheels. A standard sixty foot parcels van has been fitted up for the purpose, complete in every respect, and the performance leaves very little to be desired, for sound films are used, and there is no difficulty in hearing the spoken word. We show a section of this coach, which runs daily between King's Cross and Leeds, illustrating the division. The rear portion is the auditorium, accessible from the rest of the train by the usual corridor connections. There is a tip-up seat for each of forty-four passengers.

Rear projection is provided, giving ample space for the necessary equipment. Two forty-eight volt accumulators, charged at the end of the day's run, provide the power to drive a rotary converter, that in its turn gives the alternating current at one hundred and ten volts needed to run the projector. This part of the apparatus is the well-known Pathe sixteen millimetre type, entirely automatic in operation, and capable of a continuous run of nearly an hour. Non-flam films are used invariably.

The lighting and ventilation of the coach is electrical, of course, and the power for these services is derived from the dynamo slung beneath the underframe and belt-driven from the wheels. A later and more up-to-date coach will have the driving batteries also charged up in this way from a second dynamo.

the bottom of the wreck. The first intimation those on the salvage steamer above had of the accident was the sight of their manager floating unconscious on the surface. However, he soon recovered.

The work in the wreck before it is raised goes on for months, for not only has it to be divided into sections, but all the bulkheads and divisions have to be strengthened and reinforced to withstand the terrific pressures to which they are later subjected.

The final thrill comes when the wreck is raised. The salvage steamer, with the huge compressors which pump air into it at the rate of five thousand cubic feet a minute, moves off a safe distance, lengthening the pipe lines which connect it to the airlocks jutting out of the water.

These compressors, the most powerful afloat, are set going at full speed, and gradually the water in the various sections of the wreck is pressed down. Then a movement is seen and the airlocks rise a foot or two, showing that the wreck is dragging itself clear of the mud in which its superstructure is firmly anchored.

Suddenly, with a rush, and in less than

ten seconds, the whole twenty-five thousand ton mass rises to the surface. Terrific fountains of oil and mud and water shoot up. And so fast is the rise that even when the wreck is ten feet or more above the surface walls of water six feet high can be seen cascading off it.

The airlocks, of whose height only ten feet or so was visible a few seconds before, now stand two hundred feet in the air, the whole forest of bracing wires showing.

And sitting on the top of one of them all the time has been an engineer whose duty it was to watch the pressure gauges. You can imagine his feelings, being ten feet above the water one moment and then thrown two hundred feet into the air in less than ten seconds with a twenty-five thousand ton ship appearing beneath him!

When I asked one of these men about this experience all he would say to me was, "Never again, never again!"

But this is not the end of the job. The wreck has to be prepared for its journey south to Rosyth, on the Forth, to be broken up.

And all the time the pumping must go on, because the bottom, or rather, what used to be the deck of the ship, is open to the sea and the compressors have to keep pressing the water down to prevent the wreck from sinking.

The superstructure which would foul dock entrances down at Rosyth has to be blasted away and dropped to the bottom again. Then houses are built on the up-turned hull to house its crew and the compressors which will take over the duties of those on the salvage steamer when the wreck begins its long journey to the south. Although there have been times when mishaps have been very near, they have never really happened and all the giants have been brought safely to Rosyth.

Already the tonnage of the ships raised from the bottom of Scapa Flow totals two hundred and fifty thousand and there are several more twenty-five thousand-ton battleships, apart from the *Grosse Kurfürst*, on which the men have worked.

By the time they are all raised the total will be nearly four hundred thousand tons, a world's record salvage feat.

(Above left). The huge 20 ton airlocks just coming to the surface as the ship below the water, on to which these great pipes are bolted, comes to the top. (Above) Looking down one of the air locks; view from the top showing the compression chamber (4 feet down) in which the air pressure is regulated to accustom the body to the pressure below.



Salvors at work inside the upturned ship, making a hatch water-tight against sea pressure.

Modern

WONDER

The Pictorial Review

EVERY WEDNESDAY

No. 106
Vol. 5

2d

MAY 27
1939



HOW A GUN IS
MADE

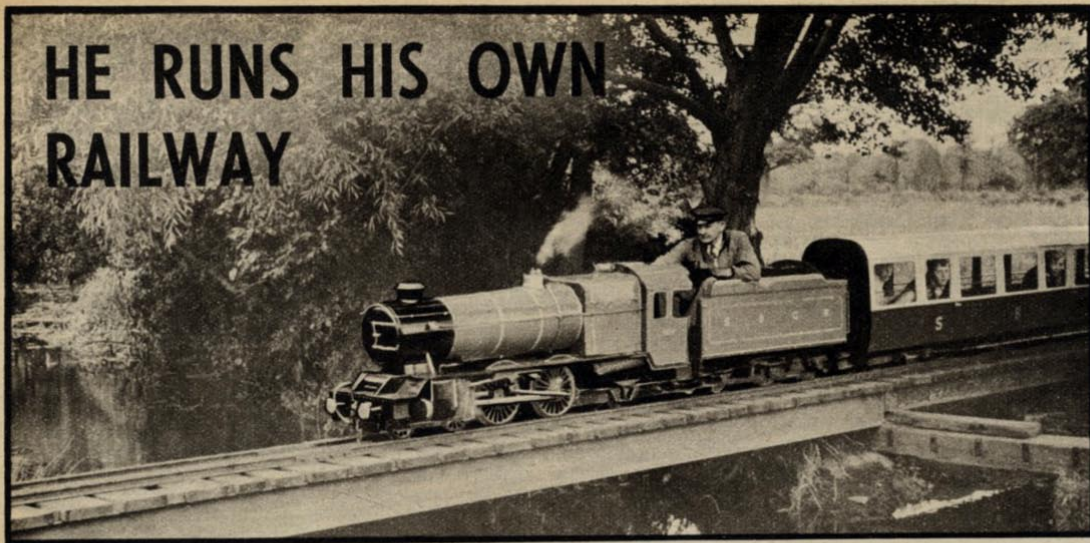


ELECTRIC WRITER



WORLD'S STRANGEST MONKEY

HE RUNS HIS OWN RAILWAY



ON a private estate, thirty miles south of London, operates this miniature railway — millennium of every boy's dreams.

The railway is the property of the wealthy banker Mr. Alexander Kinlocks, who started the scheme some years ago as a hobby. The hobby not only proved its worth for the purpose for which it was designed, but also proved a good financial proposition. Mr. Kinlocks decided to turn it into a limited company.

Everything about this miniature railway is an exact replica of the real thing. Booking offices, printed tickets, platforms and porters, and naturally all the engines,

rolling stock, signals and so on, conform as nearly as possible to those used by the four big railroads.

The track is two miles in length and during the journey passengers pass through woods, over bridges, travelling through beautiful countryside all the way along the trip.

The Pullman carriages are a unique feature about these trains.

The locomotives, exact replicas of the real things, are fired by coal, and each engine cost £600.

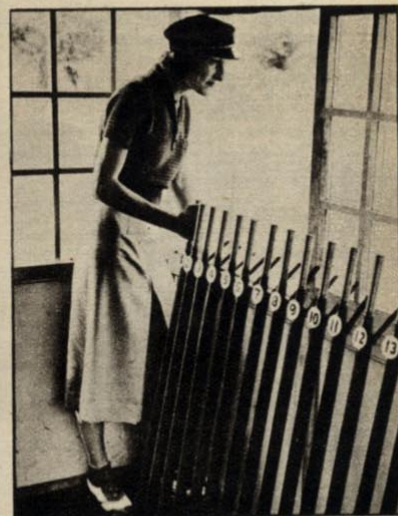
The adult passengers pay a fare of ninepence for the four-mile circuit in the Pullman cars, and 6d. to travel in the open

coaches. Children, who it will be seen from the pictures do not form the great majority of the passengers, pay only half price.

During the week the railway is worked by special workers, but when the weekend comes and it is their time off, Mr. Kinlocks himself and two or three friends become the operating staff.

The whole of the track is served by a signalling and telephone system to ensure absolute safety.

There are many who are envious of Mr. Kinlocks's possession, and who wouldn't be? A model railway like this is something worth playing with.



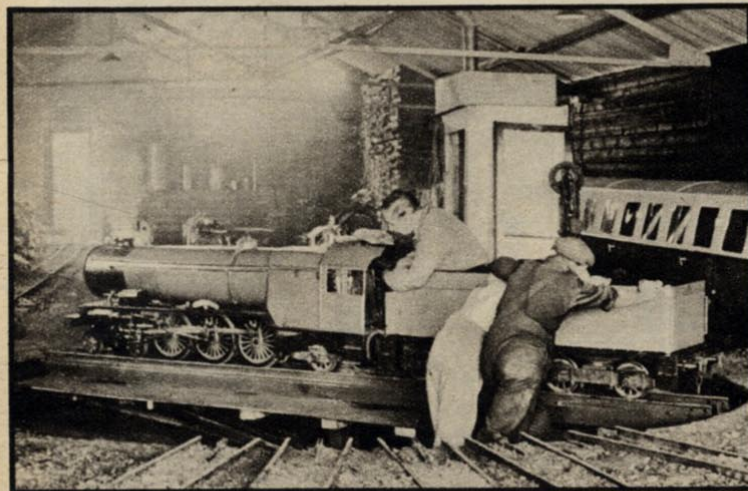
Ladies get the model railway bug as well. Here in one of Mr. Kinlock's signal boxes is one of his most enthusiastic helpers. To ensure absolute safety on the track, a full signalling and telephone system is used.



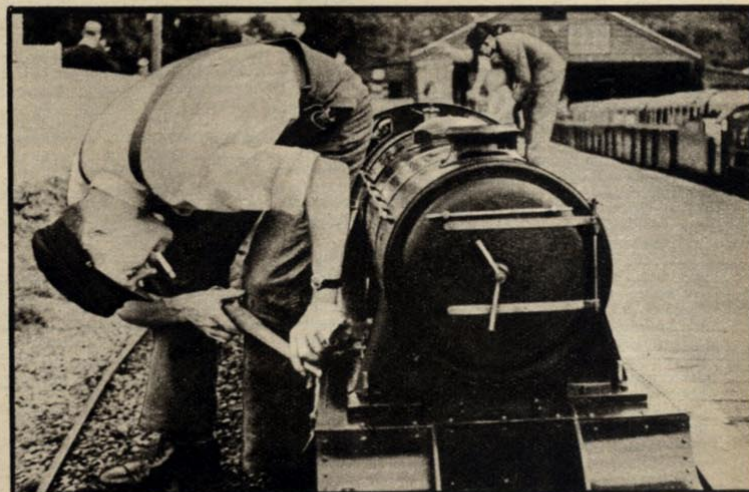
The main station of the line where the trains are prepared for their journeys.



Operating exactly as real locomotives, these engines need water, too.



The model is complete with its own workshops. Here many of the repair jobs are done. One engine is at present on the turntable.



Mr. Kinlock, owner of the novel railway, oiling one of his engines. The locomotives are fired by coal and cost £600 each.

SOME OF THE PRINCIPAL GUNS USED IN THE ARMY TODAY

(The ranges must be taken as only approximately correct)

9.2-INCH COAST DEFENCE GUN



320 lbs.

RANGE 20,000 YARDS

8-INCH HOWITZER



250 lbs.

RANGE 18,000 YARDS

6-INCH HOWITZER



100 lbs.

RANGE 15,000 YARDS

60-POUNDER (5-INCH) GUN



60 lbs.

RANGE 15,000 YARDS

18-POUNDER (3.3-INCH) GUN



18 lbs.

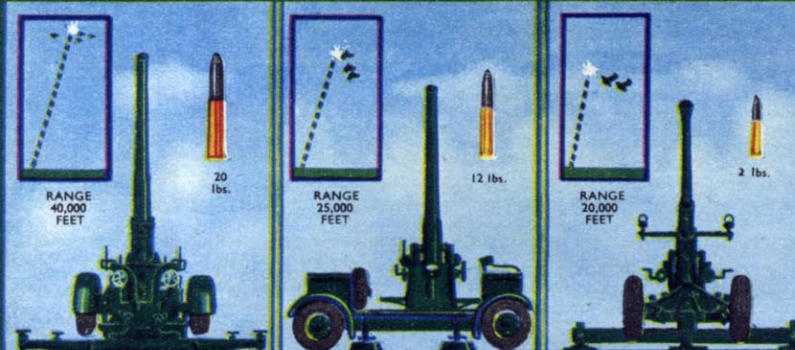
RANGE 8,000 YARDS

2-POUNDER ANTI-TANK GUN



2 lbs.

RANGE 3,000 YARDS



RANGE 40,000 FEET

20 lbs.

RANGE 25,000 FEET

12 lbs.

RANGE 20,000 FEET

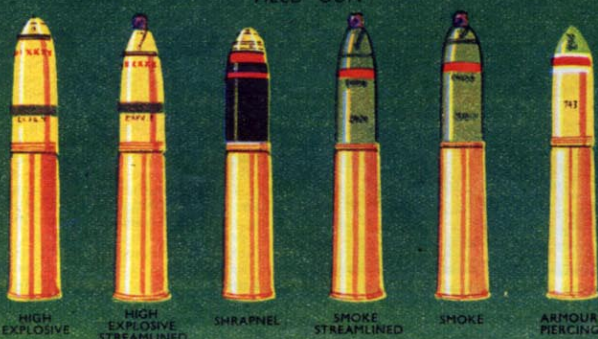
2 lbs.

1.7-INCH ANTI-AIRCRAFT

3-INCH ANTI-AIRCRAFT

40-MM ANTI-AIRCRAFT

MARKINGS OF AMMUNITION USED WITH AN 18-POUNDER FIELD GUN



HIGH EXPLOSIVE

HIGH EXPLOSIVE STREAMLINED

SHRAPNEL

SMOKE STREAMLINED

SMOKE

ARMOUR PIERCING

STAGES IN THE MANUFACTURE OF A 14-INCH NAVAL GUN.

STAGE 1
The molten steel is drawn from a furnace and poured into a mould to form a seventy-five-ton ingot. This ingot, after being reheated or "soaked" to an even temperature all through, is then taken to a forging press shown and beaten out to a length suitable for the gun tube.

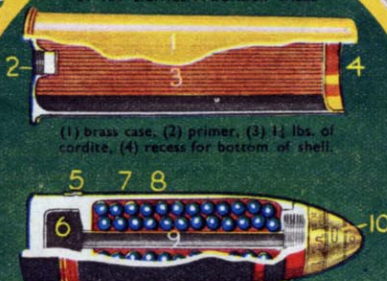
STAGE 2
After several more forgings and heat treatments the tube is sent to be annealed after which it is rough machined inside and out and then hardened and tempered in an oil bath. After testing it is machine finished as shown. This is the inner or "A" tube of the gun.

STAGE 4
The built-up gun is now machine bored and finished and ready for rifling as shown. The rifling inside a gun imparts a twist to the shell on its passage through the barrel. (1) The cutter, (2) cutter support, (3) spirally-cut bar imparting twist to cutter, (4) bar rest.

FINAL STAGE 5
Section of completed gun with its principal parts. (1) "A" tube, (2) B hoops, (3) C hoops, (4) D hoops, (5) jacket, (6) breech ring, (7) breech mechanism, (8) breech block, (9) chamber, (10) rifled barrel.

Inside the turret of a 13.5-inch Naval gun. The practice shell (5) is just about to be rammed into the breech (2) while the cordite charge (6) has just arrived in the cage above the shell. A firing tube (4) is being inserted into the breech block (3) and this fires the charge electrically by connections at (1) when the charge has been inserted into the breech behind the shell and the breech closed.

THE CARTRIDGE CASE OF AN EIGHTEEN-POUNDER SHELL

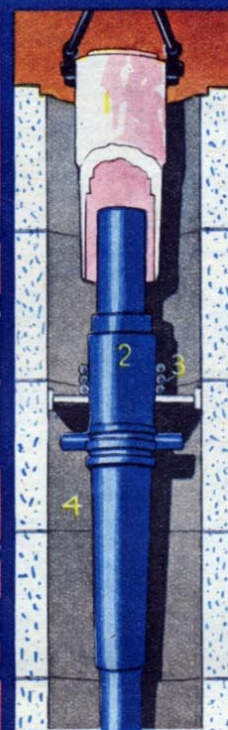
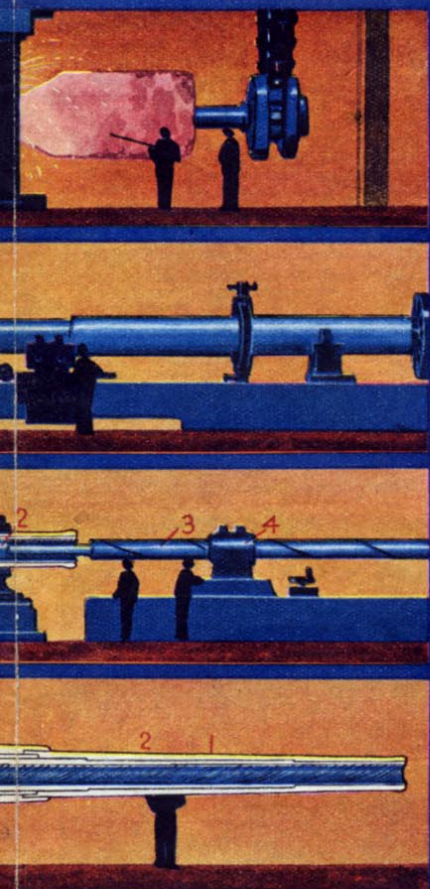


(1) brass case, (2) primer, (3) 1 1/2 lbs. of cordite, (4) recess for bottom of shell.

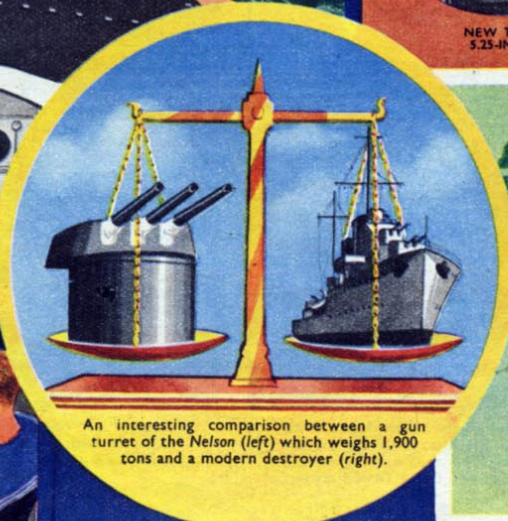
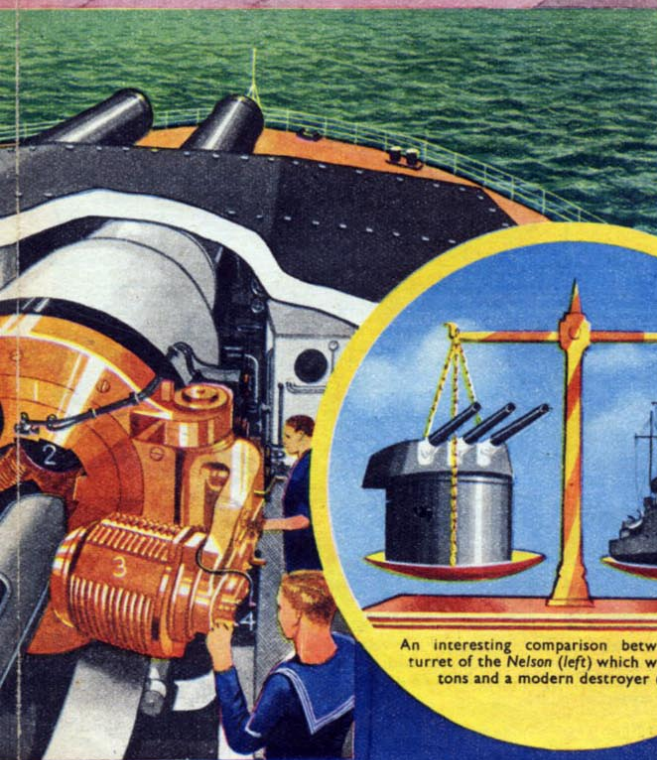
Details of a modern shrapnel shell: (5) driving band which fits the rifling of gun, (6) gunpowder bursting charge, (7) steel balls, (8) resin, (9) metal tube, (10) time fuse

NS!

GUNS are a question of topical importance today and without being warlike we show on these pages some interesting facts and figures about them. Directly below are shown some stages in the manufacture of a 14-inch naval gun; the subject is simplified for clearness as there are many other processes. The left hand of these two pages is confined to Army guns, the right to Naval guns



STAGE 3
Other ingots have been drawn out and machined to fit over the "A" tube to form the completed gun, and these "hoops" as they are called are shrunk on to the tube while still hot. (1) Hot jacket being lowered on, (2) gun tube and other hoops, (3) cold-water pipes, (4) concrete shrinking pit.



An interesting comparison between a gun turret of the Nelson (left) which weighs 1,900 tons and a modern destroyer (right).

SOME OF THE PRINCIPAL GUNS USED IN THE NAVY TODAY

(The ranges must be taken as only approximately correct)



2,461 lbs.



TRIPLE 16-INCH

RANGE 35,000 YARDS
(20 MILES)



1,920 lbs.



TWIN 15-INCH

RANGE 28,000 YARDS



1,800 lbs.



NEW QUADRUPLE 14-INCH

RANGE, PROBABLY 34,000 YARDS



256 lbs.



TWIN 8-INCH

RANGE 20,000 YARDS



100 lbs.



TRIPLE 6-INCH

RANGE 16,000 YARDS



45 lbs.

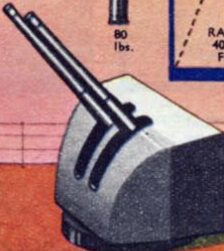


TWIN 4.7-INCH

RANGE 10,000 YARDS



80 lbs.

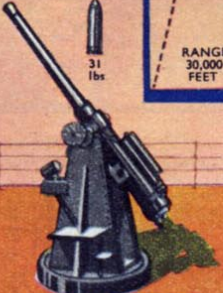


NEW TWIN 5.25-INCH

RANGE 40,000 FEET



31 lbs.

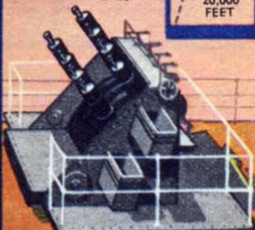


4-INCH ANTI-AIRCRAFT

RANGE 30,000 FEET

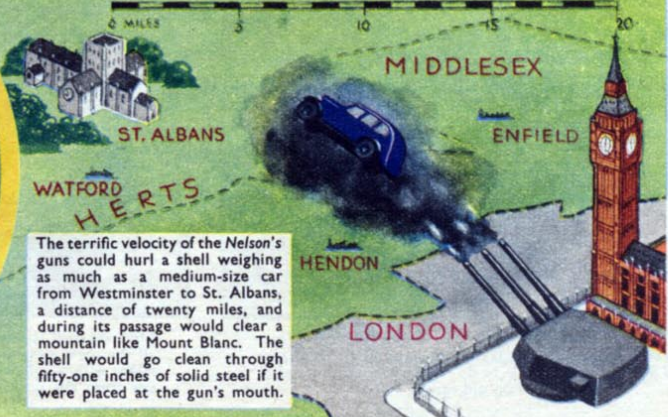


2 lbs.



MULTIPLE 2-POUNDER POM-POM

RANGE 20,000 FEET



The terrific velocity of the Nelson's guns could hurl a shell weighing as much as a medium-size car from Westminster to St. Albans, a distance of twenty miles, and during its passage would clear a mountain like Mount Blanc. The shell would go clean through fifty-one inches of solid steel if it were placed at the gun's mouth.

Modern

WONDER

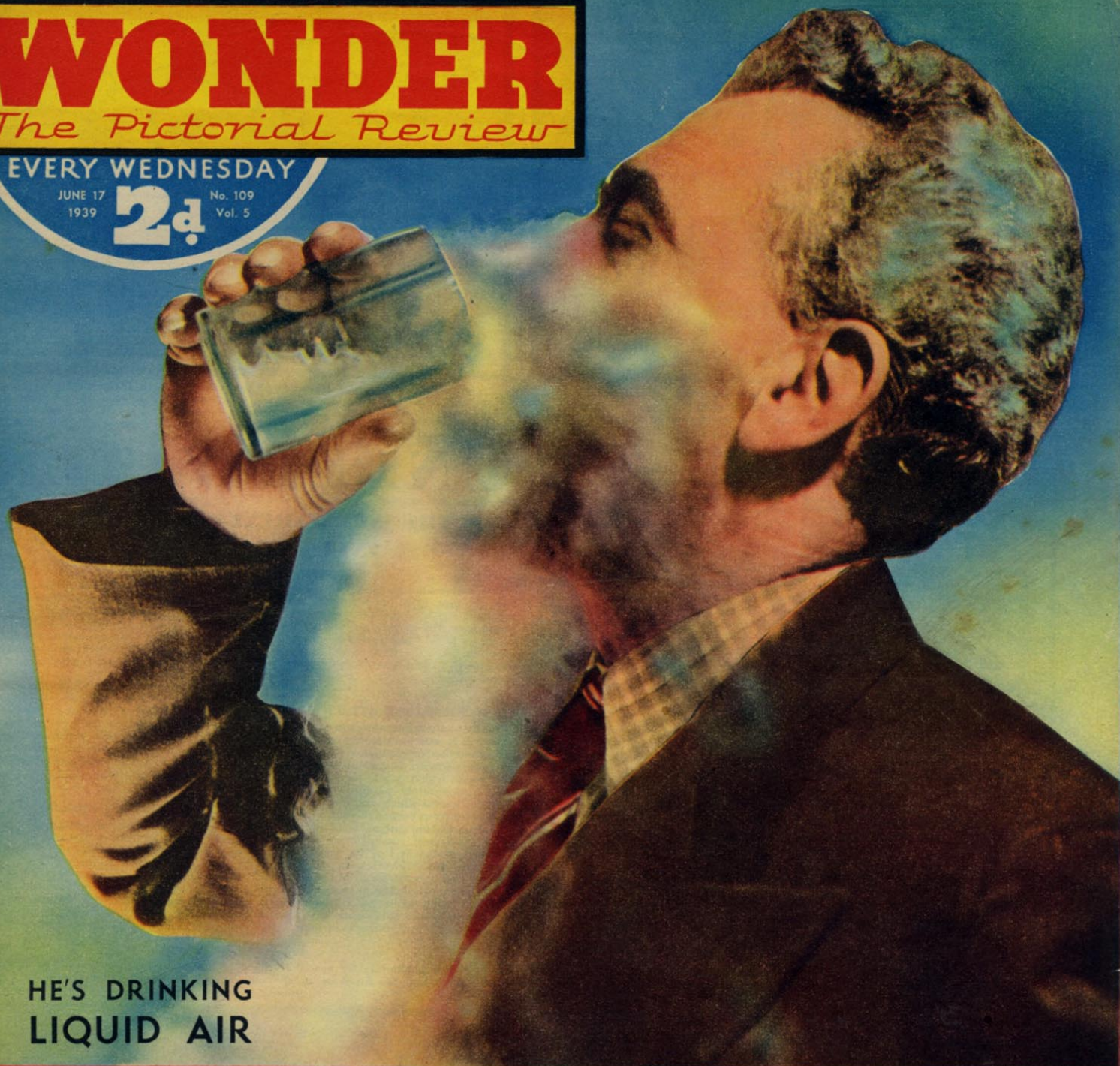
The Pictorial Review

EVERY WEDNESDAY

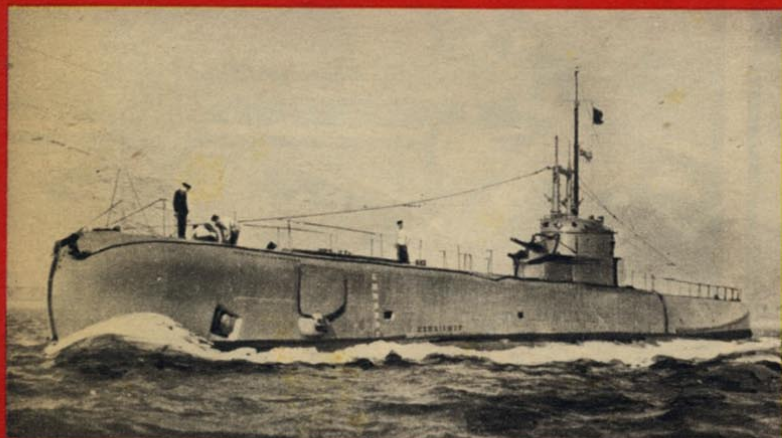
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No. 109
Vol. 5



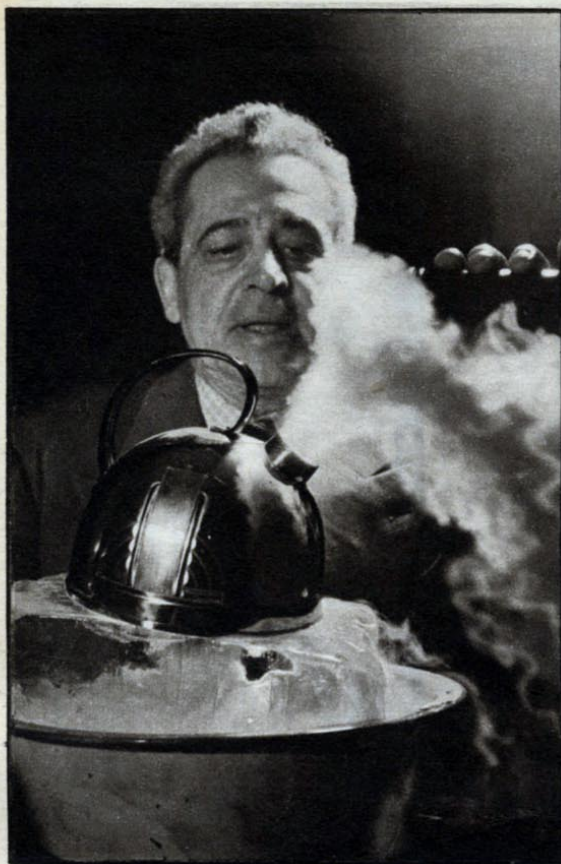
HE'S DRINKING
LIQUID AIR



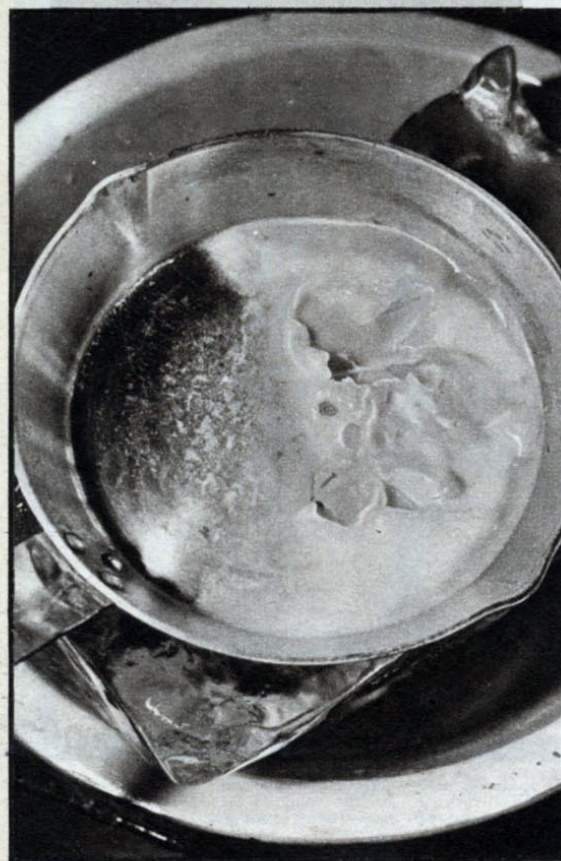
BRITAIN RULES UNDER THE WAVES



DAY IN THE LIFE OF A FIGHTER PILOT



When a kettle of water is brought down to a temperature of 265 degrees below zero it will boil if placed on ice. A similar trick is sometimes done with "dry ice" or solid carbon dioxide. When a piece is dropped in water it makes the water appear to boil.



This picture, taken of an egg frying as it stands on ice, is real, but the egg had first been treated with liquid air. The temperature was reduced to 100 degrees below zero so that when the egg was put on ice the temperature seemed to be really hot.



Water Boiled ON ICE

LIQUID AIR BOMBS
HIGHLY EXPLOSIVE

YOU have been a steady consumer of air since the day you were born, but how much do you know about it? You probably know that its principal component parts are the gases oxygen and nitrogen; that if your supply of air is cut off for only a few minutes you will die, so that makes it a life-saver.

But not many know that air can be one of the deadliest explosives. This last was demonstrated during the Spanish Civil War, when bombs filled with liquid air wrought havoc wherever dropped.

The blast from one of these bombs has killed persons one-eighth of a mile from the scene of the explosion and seriously injured people a quarter of a mile distant.

While liquid air has been used for many years in Great Britain, in motor car plants, in the manufacture of electric light bulbs and radio valves and in many hospitals, it has remained totally unfamiliar to the great family of Mr. and Mrs. John Bull.

There are 114 plants that manufacture liquid air in America alone. These plants work night and day to keep up with the demand. New uses are being found for it every day, but as yet the scientists say, the surface has only been scratched.

TREMENDOUS PRESSURE NECESSARY

To the layman who is partly acquainted with liquid air, it is just a "stunt substance," handy for doing tricks. But liquid air is no toy and is capable of dire results if wrongly handled.

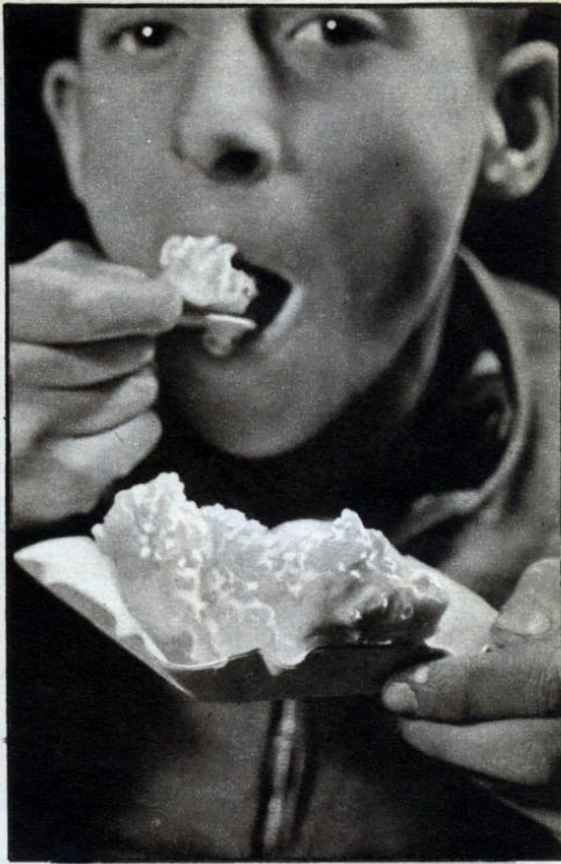
The photos on this page take you to the Superior Air Products Company plant in Newark, New Jersey, and show you liquid air in the making. They also show you some of the tricks that can be done with liquid air.

You may call this "parlour magic" but it serves to make the people acquainted with something that one day may play an important part in their lives. Demonstrations pictured here are given by Clarence L. Rivers, L.L.A., who has lectured on liquid air and demonstrated it thousands of times.

To make air liquid tremendous pressure is applied, and temperatures as low as 265 degrees below zero are reached.

The industrial uses of liquid air are rapidly increasing. It is very useful in the manufacture of ammonia, and for the preparation of argon, which plays an important part in brightening our cities with coloured illuminated signs.

This new discovery of liquefying gases has made it possible for the scientists to make use of the atmosphere for obtaining a large variety of gases which are contained in air in very small quantities. Over thirty factories in this country suck ordinary air into special machinery, and break it up into its different constituent parts.



A new way for getting immediate supplies of ice cream. With a container of liquid air handy you can make ice cream without waiting or work. Just one squirt of liquid air freezes the mixture and produces a nice cooling ice.



The process of making liquid air is first to wash and dry air in tanks, then subject it to tremendous pressure of about 3,000 pounds a square inch. As pressure increases temperature drops and goes down to about 128 degrees below zero by the time the air liquefies.



AERIAL BOMBARDMENT FROM SPACE

METEORS are bodies of solid cosmic matter entering the earth's atmosphere at great velocity from without. Those that fall to the surface of the earth are known as meteorites.

Every day and every night the earth is bombarded by these tiny visitors from outer space at an estimated rate of a million an hour. That sounds highly spectacular until we perform a little calculation and find that only ten-millionths of that number can be seen by a single observer, because his eyes can command only a small part of the earth's atmosphere. On certain nights of the year, however, the number increases greatly, and occasionally a brilliant display is observed.

At first thought, it appears singular that certain nights of the year should be set aside as occasions for unusual meteoric activity. What connexion is there between our calendar and events that take place in outer space?

We must recall that our year is simply a measure of the time required for the earth to complete its journey around the sun. If we draw upon a sheet of paper the approximate circular annual path of the earth, we can soon determine at what date the earth will reach any given point along the path. Furthermore, the earth will pass

that point regularly at intervals of one year, and any local disturbance going on in that vicinity of the solar system will be experienced by us each time the earth passes the point.

The vast expanse of the solar system is crowded with swiftly moving bodies. Some of these might be called celestial junk—the debris of planets formed billions of years ago. Traffic jams and collisions are inevitable because of the vast number of such particles.

While most of our tiny planetary neighbours probably follow a lonely path through space, a considerable percentage of them travel together around the sun in huge swarms. In many cases there are innumerable swarms travelling the same path, so that they form an almost continuous elliptical ring of debris around the sun.

How many such ring systems there are we cannot guess, but some of them we know quite well because they cross the path of the earth.

At intervals of exactly one year the

earth reaches each debris ring intersection, and on such occasions we usually have a fine meteor shower.

The earth not only collides with meteoric particles, but it actually sucks them in by virtue of its strong gravitational pull. They come hurtling down upon us at speeds ranging from 30,000 to 150,000 miles an

hour. To objects travelling at such velocities the resistance of our atmosphere becomes enormous.

The meteor is immediately heated to incandescence by the compression of the air in front of it. The frictional heat generated as the body ploughs through the atmospheric molecules vaporizes the surface material.

Small meteors do not last long under such brutal punishment, and the average meteor burns up completely before it can descend to within fifty miles of the earth. But about once a day on the average, the earth sweeps up a chunk of rock or metal so large that it is not entirely consumed.

If you happen to see one plunging downward into your garden in a blinding glare of white heat, you need not hesitate to go out and pick it up. The meteorite will be quite cold by the time you reach it. The explanation of this paradox lies in the extremely low temperature of the body before it enters the atmosphere, through which its transit lasts but a few seconds. Though its surface temperature may rise to several thousand degrees, the heat has no time to penetrate into the cold interior of body.

It is a curious fact that although several hundred meteorites probably strike the surface of the earth each year, there is not a single known case in which a person has been killed by one.

Thousands of years ago a meteorite of colossal dimensions struck the earth near Canyon Diablo, Arizona. All we know about it is that it left a crater in the soft stone desert nearly a mile in diameter and some six hundred feet deep. If a similar projectile should land in the heart of a large city, the ensuing destruction of life and property would, of course, be appalling, but the probability of such a calamity is too minute to cause concern.

Meteorites are of great interest to the astronomer, because they alone, of all the types of objects he studies, can actually be handled and subjected to laboratory analysis. Compared with the planets and the stars, the largest meteorites are utterly insignificant, but, nevertheless, they are true samples of things beyond the earth.

Some resemble terrestrial rocks in appearance and composition. Others are composed almost entirely of nickel-iron. All in all, one-third of the ninety-two chemical elements have been found in meteorites, and not a single new element has been discovered in any of them. These findings confirm our belief that the material of the earth is universal in character.

Meteor swarms are simply little comets or the scattered remains of comets that were once spectacular. Comets are vast collections of boulders, rocks and particles. As they race in their elliptical courses around the sun, they gradually scatter their substance along the path and eventually disintegrate into ordinary meteor swarms.

The Draconids, as these meteors are called, were first observed on October 9, 1926, when the little comet Giacobini-Zinner was near at hand. A study of the meteors revealed that their paths in space coincided with that of the comet. In July 1933, this comet returned, and the brilliant Draconia shower followed on October 9, when the earth crossed the comet's tail. Little Giacobini-Zinner is scheduled to return early in 1940.



The most remarkable picture of a meteorite flashing across the sky.



AS THE DEADLY GAS EXPANDS AND RISES SLOWLY, CAPTAIN LUPI CRACKS UNDER THE STRAIN. ZARKOV QUICKLY CHECKS HIS HYSTERICAL CRIES OF—"AIR—GIVE ME AIR!"



FLASH, AS COOL AS THE SURROUNDING ICE, AIMS A HEAVY RAY-GUN AT THE CEILING AND HURLS A NARROW BEAM THROUGH THE ROOF.



HE RACES DEATH TO DRIVE A SECOND, LOWER OPENING THROUGH THE ICE MOUNTAIN, THIS CREATING A DRAFT—A DRAFT WHICH SUCKS THE DEADLY POISON FROM THEIR FROZEN PRISON!

~*~ NEXT WEEK ~*~
THE MOUNTAIN PRISON

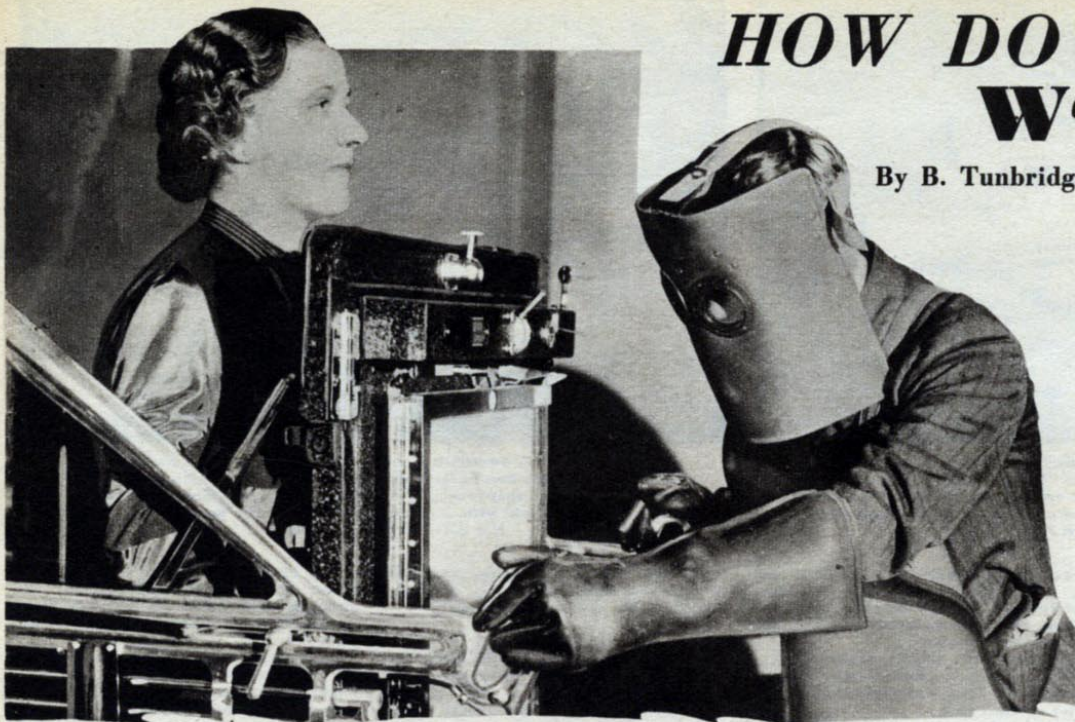
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HOW DO X-RAYS WORK?

By B. Tunbridge

READ your newspaper almost any day and you are nearly certain to find some mention of X-rays. X-rays being used for this, or X-rays being used for that; a new use in medicine or a method that industry has discovered which makes these unseen rays do a job much more accurately than is possible with human labour.

But whilst the useful radiations have always been there for mankind to use, their discovery is a comparatively recent one. In 1895 Professor Rontgen, who occupied the chair of Physics at the University of Wurtzburg in Bavaria, was experimenting with electrical apparatus in his laboratory and accidentally discovered that there were certain radiations in the neighbourhood of a vacuum tube he was using.

Even when it was realized that the rays which were produced would penetrate certain substances, like human flesh, and act upon a photographic film, the competent medical authorities of the time did not realize that this new discovery would have any important influence on the treatment of disease.

Finding that X-rays, or Rontgen rays as they are sometimes called, existed, did not explain what they were, but science soon found that they were a form of electro-magnetic radiation which travels through space at tremendous speed.

Scientists often use long words to explain what they mean, so unless we ordinary people understand exactly the meaning of

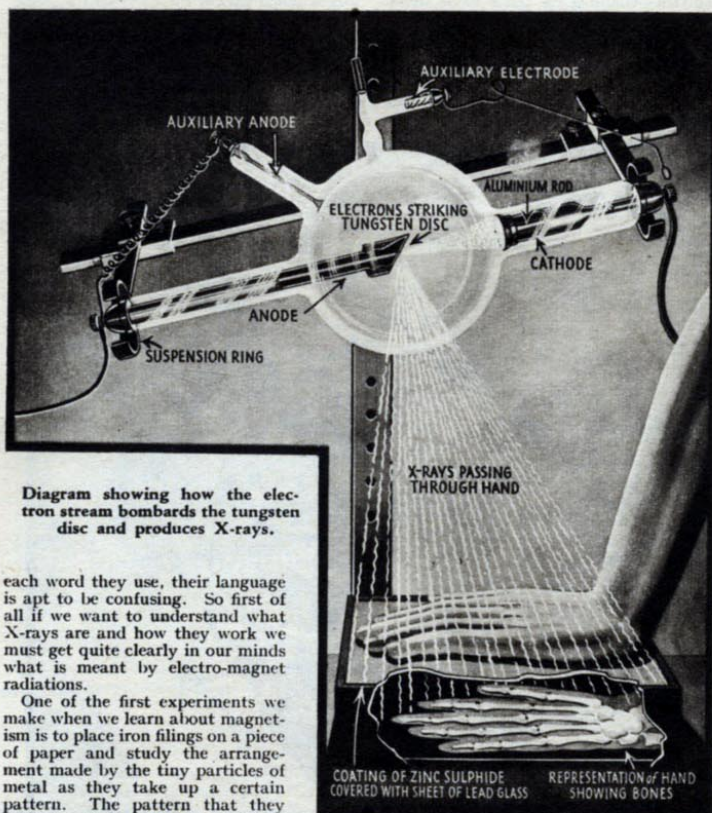


Diagram showing how the electron stream bombards the tungsten disc and produces X-rays.

each word they use, their language is apt to be confusing. So first of all if we want to understand what X-rays are and how they work we must get quite clearly in our minds what is meant by electro-magnet radiations.

One of the first experiments we make when we learn about magnetism is to place iron filings on a piece of paper and study the arrangement made by the tiny particles of metal as they take up a certain pattern. The pattern that they form is caused by what we call a magnetic field, and we soon learn that the arrangement of the particles is caused by the strength of this field varying at different parts of the pattern.

The electro-magnetic radiations travelling through space are a similar kind of thing, but instead of the magnet being stationary and throwing out a field in certain fixed directions, it travels through empty space, and at the colossal speed of over one hundred and eighty-six thousand miles a second.

And these impulses whizzing past us all the time have a number of varying forms: wireless waves at one end of what is called the "spectrum," and the waves from radio-active substances like radium, at the other. Between the two extremes are light, ultra-violet rays, and the invisible, but powerful X-rays.

existence of X-rays, it was not difficult to produce them, because it is only necessary to hit a piece of hard metal sufficiently violently with a stream of electrons. In practice this is done in a vacuum tube. In one end of the tube there is a filament—something like that in a wireless valve—and at the other a plate or target of some heavy metal, such as tungsten.

This plate has a big voltage of somewhere around one hundred thousand volts on it, and as the electrons stream from the filament to it, a terrific bombardment takes place.

Because the electrons in the metal target try to dodge the stream of electrons bombarding them they jump about, and the energy they produce in doing so creates the radiations we call X-rays.

Now that we know that such rays exist you may wonder what use they are, and how science has been able to apply them to solving some of our many problems.

Well, X-rays are a form of ultra-violet rays that will penetrate through certain materials with sufficient intensity to act on a photographic plate, and this makes it possible for parts of the body, invisible by other means, to be studied and proper treatment given according to the results discovered on the photograph.

This was its first use in medical science, and very valuable too. A broken bone could be examined by concentrating X-rays on one side of the damaged limb and putting a fluorescent screen or photographic plate wrapped in black paper, to keep out ordinary light, on the other.

The rays easily penetrate the flesh, but when they come to the bone the photo shows the dark outline of the solid matter. Here was a straightforward use for the new discovery, but when science wanted to examine other parts of the body means had to be devised for making the part show up against the surrounding flesh.

Science rarely stands still, so the pioneers of X-ray found that if they gave a patient, whose stomach they wanted to examine, a meal of barium salts, the chemical coating of the stomach would make it show up, and they were able to see on the photograph anything that was wrong.

They also found that iodine compound would show up the lung from the surrounding tissue, and a hospital patient who has had a few drops of this chemical, displays an elaborate "tree" formation of the air passages on an X-ray photograph.

Later, researchers found that there were different kinds of X-rays, having various wavelengths, and that some kinds would penetrate flesh whilst others would go through steel. This property of the rays opened an industrial use for the newly discovered force of nature. It was found that X-rays directed on steel manufactured products would immediately reveal any flaw in welding or casting, and this made possible a form of commercial inspection far more accurate than any of which the human eye was capable.

But of all the uses found for X-rays the most important from the purely scientific angle is the way in which the experts have been able to study the nature of matter through its use. You have often read about the arrangement of the atoms in all kinds of solids, and probably you have wondered how scientists could state so positively that such and such a thing had a certain arrangement of its atoms.

Well, the use of X-rays is the answer. By finding out the angle at which X-rays are reflected they have been able to discover where layers exist, and by knowing the wavelength of the rays they were using they have been able to calculate how far each layer was from the next.

Medical science has been able to use these rays for curing some of our worst ills, and the latest discovery of the experts is making it possible for X-rays to help to an even greater extent the cause of healing mankind. This latest apparatus used with X-rays is known as the tomograph, and by adjusting the focus of the picture at certain depths inside the human body it is possible for certain parts to be photographed without other parts obscuring it.



The Rontgen bomb, a new X-ray apparatus used in the treatment of cancer.

A NEW STEAM-ELECTRIC RAILWAY GIANT

NEARLY two years have been spent by American engineers in designing this new 5,000 h.p. steam-electric locomotive which has just been completed for the Union Pacific Railroad. It is a distinctly new type of motive power on wheels, in fact it is an electric locomotive carrying its own power plant. Steam is generated in a patent oil-fired boiler to the terrific pressure of 1,500 lbs. per sq. in., at a temperature of 920° F. This steam passes to a superheater and then to the turbines. These turbines (of high and low pressure) are used to drive the main generator through reduction gearing of approximately 10 to 1. This generator supplies current direct to the six traction

motors situated on each axle of the six pairs of driving wheels. This is the motive power. A 220 volt alternating generator is also coupled to the same shaft as the main generator and supplies current for train air-conditioning, traction motor ventilators and other accessories.

Water is required from time to time to compensate for losses due to evaporation, etc., and this water is carried in tanks on either side of the nose of the locomotive, in front of the cab. An auxiliary turbine set is used to drive the fuel-oil pumps, boiler draught fans, compressors and the condenser fans. This locomotive is to haul the express trains between Chicago and the Pacific Coast, and is capable of 120 m.p.h.



KEY TO NUMBERS ABOVE AND PLAN ON LEFT

- | | |
|---|---|
| 1. Door to concealed coupler | 20. Special oil-fired boiler |
| 2. Door between water tanks to cabin | 21. Superheater |
| 3. Searchlight | 21A. Boiler draught fan (on plan only) |
| 4. Marker light | 21B. Auxiliary turbine set (on plan only) |
| 5. Water tank | 22. Exhaust leader pipe |
| 6. Electric windscreen wiper | 23. Driving shaft for fans |
| 7-7A. Sirens | 24. Fans for drawing air through the sides of the condensers and discharging through the roof |
| 8. Vertical light for warning at level crossings | 25. Condensers for converting used steam back to distilled water |
| 9. Dual control cabin | 26. Oil fuel tanks |
| 9A. Driver (on plan only) | 27. Outside louvres for condensers |
| 10. Exciter for main generator | 28. Rear bogie truck |
| 11. 220-volt alternator for train air-conditioning, etc. | 29. Rear driving wheels |
| 12. Main generator supplying current to the six traction motors | 30. Main control contactors |
| 13. Ventilating trunk | 31. Front driving wheels |
| 14. Gear case | 32. Brake cylinders |
| 15. High-pressure turbine | 33. One of the six traction motors driving each driving wheel axle |
| 16. Low-pressure turbine | 34. Front bogie truck |
| 17. Train heating evaporator | 35. Brake cylinder |
| 18. Exhaust steam pipe to condensers | |
| 19. Superheated steam pipe to turbines | |

Turbine set with casing removed to show blades and 10 to 1 reduction gearing. The high-pressure turbine is the further one and the low pressure in the foreground. The main generator is on the right.

